

WHAKAMOENGA CAVE, TAUPO, N94/7

A report on the ecology, economy and stratigraphy

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Abstract. Whakamoenga Cave was excavated by Trevor Hosking between 1961 and 1963. Eleven layers were established. A variety of faunal and botanical material together with artifacts was found. The layers have been grouped into three occupations on the basis of a major rockfall, a renewed occupation and the appearance of European artifacts.

Occupation 1, the earliest, contained cultural material, moa bone, the remains of numerous birds, especially bush birds, and a considerable amount of flaked obsidian. It is dated by Carbon 14 to the fourteenth and fifteenth centuries. Occupation 2 occurred after a major rockfall, which sealed off the earlier occupation. Fewer bush birds were present, suggesting considerable forest destruction had occurred. Numerous obsidian flakes were present. Carbon 14 dates suggest late seventeenth century age. Occupation 3 is represented by the four top layers. These contained artifacts of European origin. Carbon 14 results indicate that these deposits were laid down during the nineteenth century.

Whakamoenga Cave is an inland archaeological site situated on the northern shore of Lake Taupo (Figs. 1, 2). It was dug by Trevor Hosking, assisted at various times by myself and others, between 1961 and 1963. In his preliminary report on the excavation, Hosking (1962, p. 22) describes the site in detail:

[Whakamoenga Cave] is a large cave a few chains from the lake edge at Whakamoenga Point on the north-eastern shore of Lake Taupo (N.Z.M.S. 1:25,000, N94/7, 483317). The Point is the southern-most of the land-mass that forms the western shore of Tapuaeharuru Bay on which the town of Taupo is situated. The site is 1200 feet above sea level. The cave has a high arched opening to the S.E. and a smaller opening to the S.W. The front or S.E. opening is some 15 feet high and 30 feet across to where a rock column separates a further small entrance to the western chamber of the cave. The ground in front of the entrance is level for about a chain and rises up some 6 feet to the entrance, when it then slopes down gently into a hollow in the centre before rising again at the rear. To the left of the entrance are two rocks that appear to rest on the surface. Behind them and occupying most of the western chamber are further rocks of considerable size taking up most of the floor space. In the main gallery one large rock (14) projects above the floor and tops of others are just visible in the surface dust. To the north-east there is a further low chamber some 5 feet by 18 feet that runs back into the rock for a further 30 feet.

Fishermen had drawn Hosking's attention to the cave and when a road was put in to Whakamoenga Point by the owners to allow access for building on the flats above the cave, investigations were made to find out something of the history and previous ownership of the land. This included research with Maori elders, local people and the Department of Lands and Survey. Permission to excavate was obtained from the owners, Mr Butler and Mrs Gower, and work commenced in December, 1961.

One translation of the name "Whakamoenga" is "the sleeping or resting place". It appears to be an old name in the district (Hosking, pers. comm.) and the archaeological evidence tends to support this description.

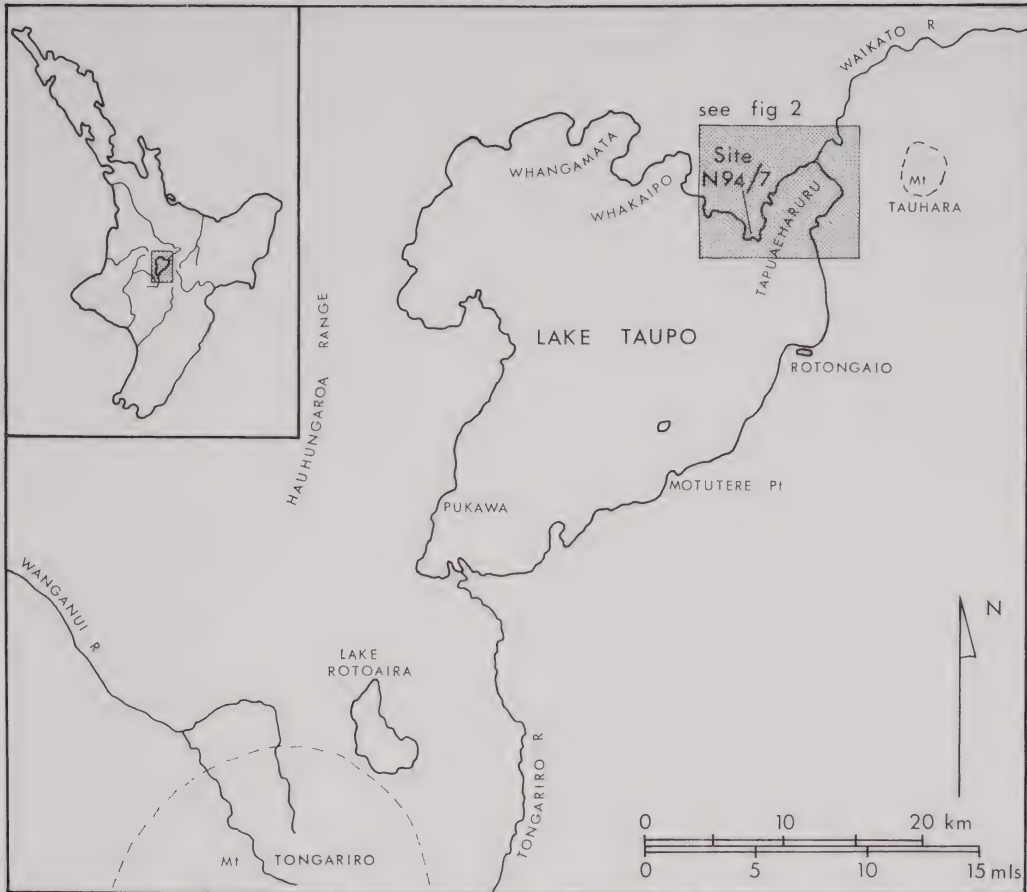


Fig. 1. Map of Lake Taupo area.

GENERAL GEOLOGY AND LAND FORMATION

The central volcanic plateau from the Bay of Plenty to south of Taupo was formed by accumulations of volcanic rhyolite rock. Into this plateau, geological faults have created upthrusts and downthrusts. These are especially noticeable in the Taupo area in the land formations along the northern and north-eastern sides of the lake. Whangamata, Whakaipo and Tapuacharuru Bays (Fig. 1) are the remains of series of these up and down thrusts, and the peninsulas between them include the one whose western tip forms Whakamoenga Point and eastern tip, Rangatira Point (Fig. 2). These faults are still active (National Resources Survey 1962, pp. 456-67).

The sheer ignimbrite cliffs at the southern end of the Western Bay of Lake Taupo are probably the result of a caldera formed by a collapse after an eruption of magma prior to the Taupo Ash Shower.

Studies by soil scientists and geologists of the thick deposits of pumice that surround Lake Taupo have shown that in the past 10,000 years many eruptions of great violence have occurred near the eastern side of the lake. The latest of

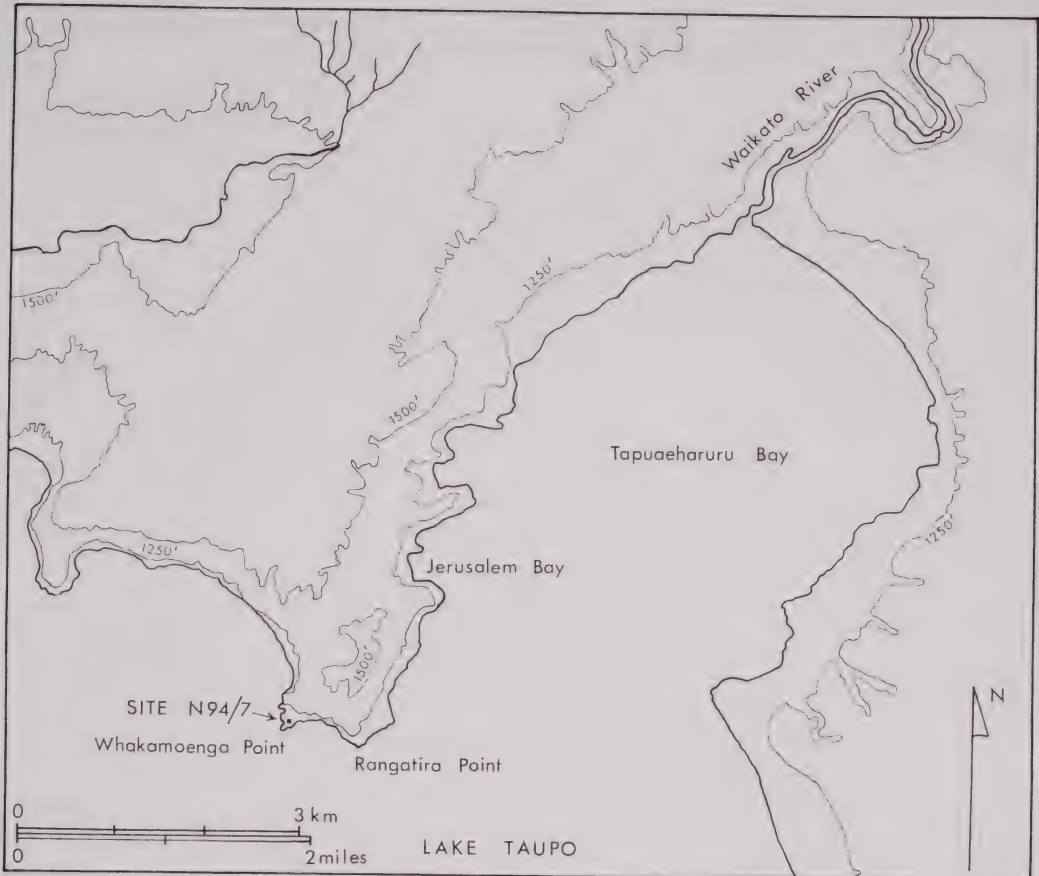


Fig. 2. Site N94/7 and surroundings.

these eruptions took place about 1800 years ago. Recent radiocarbon datings, representing a pooled date from several apparently close eruptions, place this activity at about 1819 ± 17 B.P. (Healy *et al.* 1964, p.34). These last eruptions form part of what are known as the Taupo Ash Showers. They began with a series of huge explosions of mounting intensity that spread pumice ash over the entire middle part of the North Island, destroying much of the forest and vegetation around Lake Taupo. Explosions occurred at Waitahanui and Hatepe. At Rotongaio, a vent opened at the side of the Rotongaio lagoon, eventually forming a swampy area. Later, large blocks of rhyolite and coarse pumice were deposited over the Taupo area. Boulders from this explosion litter the shores of Lake Taupo between Waipahihi and Rangatira Point. The eastern side of the lake, owing to the nature of the showers, presents a much less spectacular terrain and the land slopes gradually from the shore towards the Rangitaiki Plains.

Where the terrain is not formed by ignimbrite, cliffs occur at the 110 foot (33 m) level around the lake representing an old lake height which later fell to the present level (1150 ft, ca. 350 m a.s.l.).

The north-eastern end of the lake has been blocked by the small volcanic cone of Mt Tauhara and thick deposits of pumice breccia. This has been breached

in one spot by the mouth of the Waikato river, between the base of Mt Tauhara and the fault line that forms the north side of Tapuaeharuru Bay.

The land to the north and west of the cave for a radius of 10 km consists of steepland soils and eroded Taupo ash. To the north-east the terrain flattens out as it nears the mouth of the Waikato River. Across the river and to the east of Mt Tauhara and Waitahanui are the eroded plateaus and gullies that rise gradually up to the Kaingaroa and Rangitaiki Plains.

CLIMATE AND RAINFALL

The northern Lake Taupo area has a rainfall of less than 50 inches (ca. 1200 mm) of rain a year and it can be very dry between September and April and exceptionally dry about one year in four. Meteorological average readings for the period 1949-1970 show an average maximum January temperature of 23.4°C and a minimum of 10.8°C. The July temperature can range between 10.9°C and 1.7°C. Frosts occur at any time and can average 20-40 per year. Tender vegetation may be affected even in summer.

The erratic temperature and rainfall variations would make the growing of crops very marginal in the area and, although Governor Grey (Cooper 1851, pp. 290-92) talks of vegetable gardens at Pukawa in 1850, dependence on their regular growth would not be possible. Bidwill (1841) generally does not mention crops and talks of the cold throughout his visit in January and February.

FOREST REGENERATION AFTER THE TAUPO ASH SHOWER

Although Holloway (1954) suggested that the instability of many South Island forests was associated with recent climatic oscillations resulting in a redistribution of species and the development of new forest types, this may not apply equally to North Island forests. The central North Island, and the Taupo area especially, with its series of major eruptions up to ca. A.D. 120, has confused and concealed a maze of readjustment patterns, arising not only from climatic variation but also from extensive volcanic cataclysms.

These ash showers and flows left a huge expanse of ash and raw pumice around Lake Taupo. Its exact extent and destructive effect on the indigenous forest is not fully understood but it is thought that a series of readjustment processes would have begun mainly from the forest to the west of the lake (in the Hauhungaroa Range area and north of it) that were not destroyed by the ash showers. Possibly a small remnant on the north and east side of Mt Tauhara may also have contributed parent forest in that area (I. Atkinson, pers. comm.). Tussock and fern colonized the pumice first, followed by manuka scrub and the scrub hardwoods, such as *Pittosporum*, *Pseudopanax*, *Weinmannia* etc. tolerant of these skeletal soils. Many of the fruits of these trees are attractive to birds and there would have been an invasion of pigeons, tuis and parakeets, bringing podocarp seeds that would be deposited in droppings. Regeneration would have been irregular but with a general west to east direction (McKelvey 1963, p.11). The forest would first have been re-established at the periphery of the zone of forest destruction and then have proceeded towards Lake Taupo. These distinctive types of lower altitude forests fall into three main groups; the dense podocarp forests, the matai/rimu forests and the northern rata/tawa/rimu forests.

The dense podocarp forest, representing the pioneering stage in the centripetal colonization of the sterile pumice, was gradually replaced by the other types of forest with increasingly prominent hardwoods. It is probable that the pioneering podocarps were nearest to the lake by about A.D. 1200 but regeneration would have been irregular.

This irregular distribution of forest with its skirting scrub hardwoods separated by open areas of tussock and fern would present an ideal situation for all types of bird hunting and foraging as well as allowing easy access between the forests, where the rugged terrain would allow it.

Atkinson (pers. comm.) suggests that:

... all the remnants of the 'new forests' that we have been able to find show a 'first generation structure' and therefore their age is unlikely to be greater than 600-800 years from the present. This takes us back only to A.D. 1200-1400. So we are left with two options:

(i) an unknown factor prevented the development of forest in the tussock and shrubland that would have covered the ground following the Taupo eruption. One would have to argue that this unknown factor operated over a period of 1000-1200 years.

or

(ii) there were frequent and/or extensive fires between A.D. 120 and 1200 which destroyed most or all of the original forest that developed on the Taupo pumice thus resulting in the present forest remnants being no more than 600-800 years old.

Atkinson favours the second explanation. The causes could have been natural combustion, occurring in a climate perhaps dryer than now, or careless or deliberate burning-off by man.

He suggests that there could have been a first and second generation forest in the north-west and north-east of the Taupo area between A.D. 950 and 1300 and that it would probably have consisted of dense stands of podocarps, particularly rimu, matai, totara and miro. Following its destruction by fire, the forest would have been replaced by kamahi forest (kamahi can sprout from stumps after fire) and manuka or kanuka scrub. Kamahi leaves are present in the botanical remains found in the cave throughout the occupations and the tree is still present near the cave today (see Table 4).

The earliest occupation (Occupation 1) in the cave was marked by the large number of bush bird bones and this, together with the Carbon 14 dates for this occupation, could fit in with the evidence of bush in the Lake Taupo area and its subsequent destruction. Atkinson suggests a date of up to about A.D. 1300, at least for the initial burning off and, if the Carbon 14 dates for Occupation 1 are interpreted at the earlier rather than the later end of their range, this general date seems reasonable. However, evidence from the cave indicates that bush birds were still important until the end of Occupation 1, period 2, and that a fifteenth century date for this period was equally possible. The number of forest birds associated with Occupation 1 might indicate that some forested areas were not destroyed as early as the general botanical evidence suggests.

TRADITIONAL EVIDENCE

The early traditional evidence for the Taupo area is vague and confusing. Grace (1959) divides his book "Tuwharetoa", based on the Maori settlement of Taupo, into three periods:

1. Traditional history to the end of the seventeenth century.
2. Eighteenth century and first half of nineteenth century.
3. Latter half of nineteenth and twentieth century.

In his early period he tends to follow the "Fleet" traditions of scholars such as Percy Smith (see Simmons 1969) but his two later periods are from more recent traditions and history and are, therefore, probably more accurate.

According to Grace (1959) and Stafford (1967), Ngatoroirangi visited the Taupo area some time after the Arawa canoe landed in the Bay of Plenty. Also associated with his explorations was Tia, after whom Atiamuri, the Aratiatia Rapids and Lake Taupo-nui-a-tia were named. While visiting there they came in contact with a large tribe, the Ngati Hotu, together with another "pre-Fleet" group, the Ngati Ruakopiri. The Ngati Hotu held domain over Taupo and lands extending south-east almost to Hawkes Bay.

Of these aboriginal tribes Grace (1959, p. 80) states:

Unfortunately there are no traditions that will assist in accounting satisfactorily for the origin and distribution of the ancient tribes which the fourteenth century immigrants found established. Maori tribal history must be pieced together very largely, if not entirely, from the traditions of those who survived the warfare and struggles incidental to the clash of the invaders with their predecessors.

The Ngati Hotu were eventually defeated by a group of tribes, one amongst whom claimed Tuwharetoa as their eponymous ancestor. Of these traditionally early battles Grace (1959, p. 117) talks of that between Kawhea, son of Kurapoto of Te Arawa canoe, and the Ngati Hotu and the Ngati Ruakopiri.

When they [Kawhea's group] reached where the township of Taupo now stands they went over to Rangatira Point and attacked and captured three strongholds, Ponui, Te Kirikiri and Maunganui a Wawatai. Ponui Pa was on Rangatira Point itself; Te Kirikiri was on a low spur jutting out in the lake about three miles from Taupo; and Maunganui a Wawatai was situated on the high bluff at Whakaipo.

Kawhea continued on, but two groups stayed and concentrated their attention on lands about Taupo. They paved the way for the sons of Tuwharetoa who followed them to those parts several generations later. The two groups finally settled about Rangatira and the country extending to Rotongaio (Fig. 1).

Another tradition of the early period refers to a war party from the Mangakino area who journeyed to the southern part of Western Bay, later going on to Rangatira Point. There again the stronghold of Ponui was attacked. This pa may still be seen.

In Grace's middle period another palisaded pa, Omaunu, also situated in the same area, was the scene of fighting during the time of Te Heuheu Tukino (later killed by a landslide in 1846). From then onwards, the Rangatira peninsula is frequently mentioned in the protohistoric and historic records.

From these traditions it seems that the Whakamoenga-Rangatira area was in a crucial strategic position at the head of the lake from early times. These traditional activities should be reflected in Whakamoenga Cave, which is less than 800 m from Rangatira Point.

A broken pumice patu in Occupation 2, one in Occupation 3 (Figs. 16, 17) and traces of muskets and musket balls seem to indicate that the last two occupations may well reflect Grace's protohistoric and historic evidence for power struggles and warfare in the area.

HISTORICAL RECORDS

The first European on record to visit Taupo was the Rev. T. Chapman who established a mission station at Rotorua in 1835. He spent a short while there in January and February, 1839. Three weeks later J. C. Bidwill (1841), having stayed with Chapman at Rotorua, set out for Taupo. He was warned to make enquiries about procuring a canoe to take him across the lake as there would be difficulties getting one. Arrangements were made during the journey and Bidwill eventually arrived on the shores of Taupo. Later, he had to scramble along the cliffs at the side of the lake for about a mile to the area where the canoe was (probably Rangatira Point). The next day (Bidwill 1841, p. 36):

We embarked on Towpo about five in the morning, in a very large Ti-wai or canoe, hollowed out of a single log of wood, without top sides; those with top sides, of which they have none on this lake, are called Wa-kaw . . . This canoe was the largest of the kind I had seen; there were seventeen paddlers and about ten idlers, beside a great quantity of potatoes and my luggage. We had plenty of room, and for the first few miles went on very well. We had to cross a large bay, the only dangerous portion of our journey and till that was done I had nothing to complain of in their pulling. After that they fell off sadly. As the wind almost always blows off the east shore, we kept close under it in case of accidents; the morning was, however, very calm, and the lake as smooth as glass . . .

About eleven o'clock they arrived at a village which appears to have been Motutere (Fig. 1) having taken six hours on the journey there.

Bidwill remarks on the barrenness of the land, the steady diet of potatoes and the lack of firewood and timber. He also suggests that the land was covered with fern and became infertile because of the constant fires of a careless nature rather than because it had been cleared for agriculture but he makes no comment that this burning off might be associated with fern root production. Colenso (1880, p. 3) states that bracken fern was often burnt off in August to get the best root growth although this was a general statement about Maori food rather than one specific to Taupo.

Bidwill also comments on various plants, animals and minerals being used by the Maoris during his journey. Potatoes were growing near Taupo but these were of poor quality; a group were catching ". . . crawfish, shell-fish etc. and snaring ducks and shags, which were very abundant", in the Waikato River (1841, p. 31). Later, he saw people "making flax" which grew near the river in great abundance. Kokowai (red ochre) was being made from a mineral spring (1841, p. 35) and obsidian was common near the lake but he did not see any *in situ*. Evidence for the presence of all the above articles, except potatoes, was found during the excavation.

Although Bidwill did not comment on the use of fern root in the Taupo area, others who visited a short time later mention that it was an important item in the native diet. Cooper (1851, p. 266) who accompanied Governor Grey in a journey overland from Auckland to Taranaki in the summer of 1849-50, talks of their party being besieged by a host of wretched, ill-clad and half-starved inhabitants of Rangatira who had been living on fern root for some time. Later, Grey's group attended a feast prepared for them at Pukawa that consisted of kits of pork, kumara, potatoes, taro, calabashes of pigeons, kaka and tui preserved in oil and piles of dried fish. After which (Cooper 1851, p. 280), the Maoris: "... proceeded to dessert, which consisted of fern root roasted and beaten . . . The guests sat in a semi-circle in front of the slaves and as fast as the latter could beat the root and throw it to the former, so fast did they demolish it, apparently with great gout."

Cooper also mentions the beautifully kept cultivations at Pukawa, with about 300-400 acres (121-162 ha) under crops, producing several different kinds of wheat, potatoes, kumara, taro, pumpkins, maize, melons etc. in great abundance. This reference to pumpkins and melons growing at the southern end of Lake Taupo is interesting because *Cucurbitaceae* seeds were found during the excavation in the cave (see below, pp.56,63).

Percy Smith (Taylor 1959, p. 364) on his trip to the central districts in 1858, mentions that as they neared Pukawa they "... found an old woman who had come to grow fat upon fern root." Although Bidwill suggests that potatoes were the staple diet of the Maoris during the middle of the nineteenth century, other observers in the same areas suggest that fern root was also a staple.

Rangatira Point appeared to be a setting off or landing place for canoes travelling across the lake in historic times. Henry Williams in 1840 (Rogers 1961, p. 472) travelled from Motutere to Rangatira Point, which he describes as a very confined place upon a point projecting into the lake. Governor Grey (Cooper 1851, pp. 256-74) in his 1849-1850 trip left the point to go south. His party took $3\frac{3}{4}$ hours to cross Motutere, about 13 "lake miles", and a further $3\frac{1}{2}$ hours to reach Pukawa some 12 miles (19 km) to the south. This trip seems to have been faster than that of Bidwill (who took six hours to get from Taupo to Motutere). It appears that it was possible to go, by paddling in fairly calm water, about 25 miles (40 km) in approximately $7\frac{1}{4}$ hours, following across Tapuaeharuru Bay to the eastern shore near Rotongaio, down the coast to Motutere and then on to the southern tip of the lake.

Most travellers mention the fear that the natives had of venturing too far out from the shore, because of the treacherous nature of the lake with its sudden changes of mood. Unfortunately, there are no records of trips around the Western Bays which might give some indication of the problems involved with water transport in that area and the collection of Whangamata obsidian, which is found in some quantity in the cave. If, as Bidwell suggests (1841, p. 36), the canoes on Taupo were only "dugouts" with no side strakes they would not be very seaworthy if the lake should become rough. Records suggest that long canoe trips on the lake were only undertaken during fine weather.

It is interesting to speculate what effect the shortage of good timber near the lake might have had on the building of strong or more "seaworthy" canoes

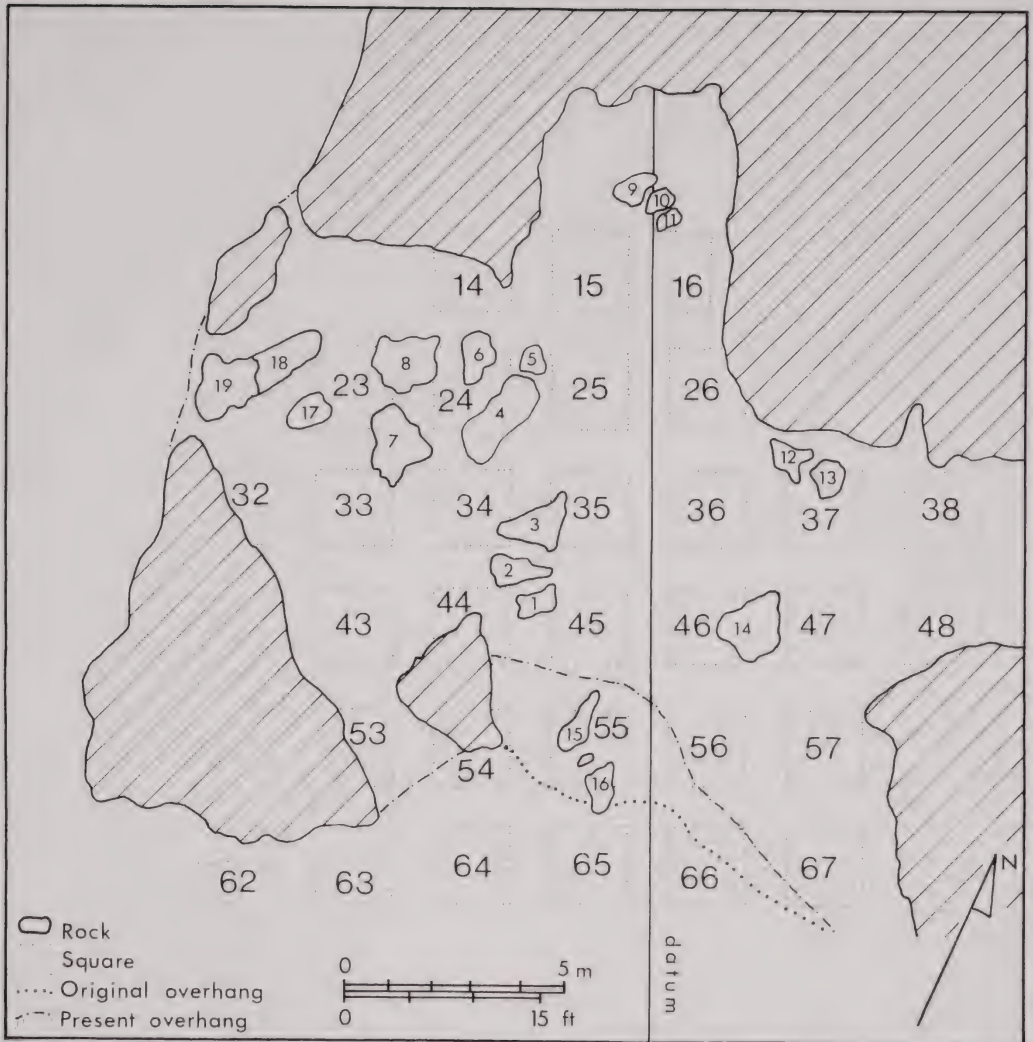


Fig. 3. Cave site plan and grid lay-out, N94/7.

after the disappearance of the forest. Historic accounts suggest that canoes were not readily available, yet to have access to one would cut the travelling time around the lake from about three days to one, and the people owning such a commodity would be at an economic advantage. The Rangatira locality appears to have been too inhospitable to recommend it as a settlement area but its geographic position, if combined with offering a service in the form of water transport, might well account for its importance in later times.

THE EXCAVATION

The setting out of the site is discussed by Hosking in his preliminary report (1962). A 9-foot (2.7 m) grid was set out, based on a central datum line running south-east/north-west from the front to the back of the cave (Fig. 3). Squares 5, 6, 13, 14, 54, 62, 63, 64 and 65 were not excavated. Only parts of squares 55 and

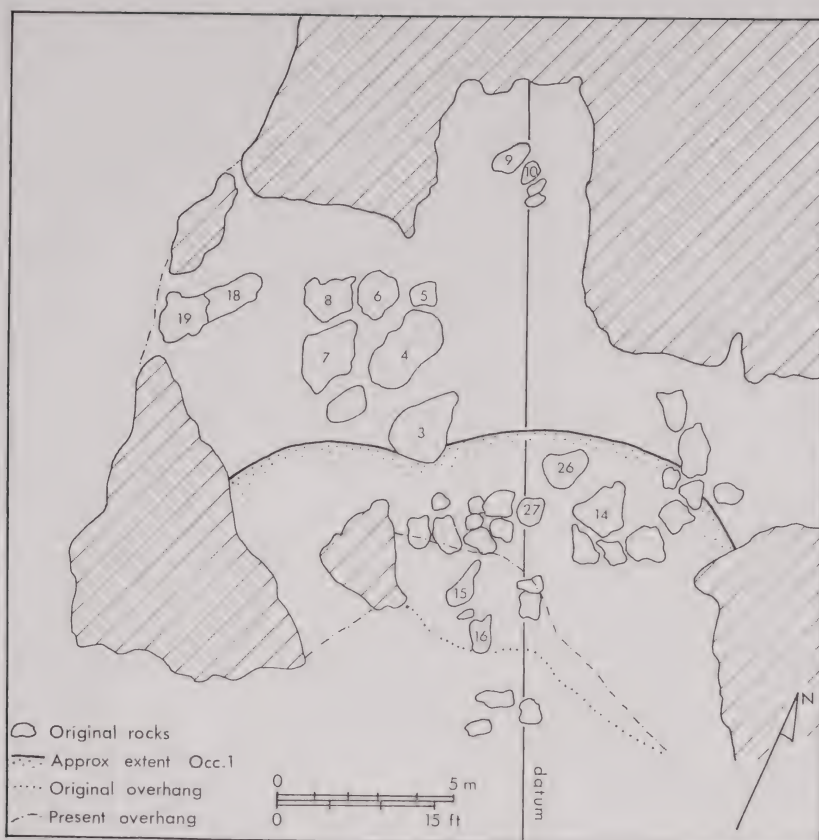


Fig. 4. First occupation floor plan, N94/7.

66 were dug because trees were growing in them and the owners had requested that the original appearance of the cave be preserved as far as possible.

Within the 9-foot squares, smaller 6-foot (1.8 m) squares were measured off, leaving 3-foot (0.9 m) baulks. Throughout this paper, the term baulks will refer to the 6-foot faces of the excavated squares, as shown by the section drawings. However, in some places it will be necessary to discuss the boundary lines between the 9-foot grid squares and these will be referred to as baulk boundary lines.

The deposits were excavated by hand trowel and sieved through $\frac{1}{8}$ in. and then $\frac{1}{16}$ in. (ca. 3 and 1.5 mm) sieves.

Hosking's original labelling of the baulks in each square was A-B, B-C, C-D and D-A but, for clarity, baulks and baulk boundary lines have been renamed according to their compass directions so that A-B becomes north-west, B-C north-east, C-D south-east and D-A south-west. The south-east baulk is the side of a square nearest to the cave entrance.

The cave floor (Fig. 3) occupies an area of about 1800 ft² (167 m²). Much of this was uninhabitable due to rocks or the lowness of the ceiling at the extremities. Large boulders scattered over the floor came from early rockfalls and these,

e.g. rocks 26 and 27 (Fig. 4), showed bases undermined by water and shingle erosion when the lake level was high enough to wash into the cave. This water action left a beach residue of ignimbrite shingle overlaid by a layer of pumice rubble when the lake level finally retreated.

In the squares near the entrance to the cave (lines of squares 50, 60) the old beach was covered with a soft, sterile, yellow layer of eroded talus material from the rhyolite cliff face above.

The south-west entrance is almost blocked by an external bank held in position by a narrow pillar of rock and rock 19 so that, although the roof is fairly high there, the bank has to be negotiated before reaching the outside. This bank appears to have been formed naturally by rock fall and earth piling up against the outer wall. It may also have been artificially added to as a wind-break, because the opening exposes the cave to the cold, southerly winds. This area was not excavated. The north-east chamber is narrow and low beyond squares 38 and 48. This chamber once had a small opening but it is now filled with earth. The deposits gave no indication that time spent excavating the extremities of these two areas would have been profitable. Figure 4 shows the probable appearance of the cave floor as it would have looked to the first occupants.

The cave roof above the south-eastern entrance was previously several feet forward of the present edge so that originally the recess of the cave beyond the 30/40 baulk boundary line would have been poorly illuminated. Rock 14 would have dominated the central area of the cave, as it stood about 5 feet (ca. 1.5 m) above the floor.

Other water-worn rocks such as 3, 26 and 27, which rested on the cave floor, would have stood about 2½-3 feet (ca. 0.75 - 0.9 m) above the floor during the first occupation. The south-west chamber rocks (19, 18, 8, 7, 6, 5 and 4) were of similar nature but the first occupation did not extend into this area. Later roof falls were scattered over the shingle surface, especially in squares 45 and 47, thus reducing the living floor space considerably. The relationship of rocks 15 and 16 to the floor was not established, as trees prevented full excavation of square 55.

STRATIGRAPHY AND OCCUPATION SEQUENCE

Hosking excavated 11 layers, the deepest being layer 11, where the cultural material rested on and amongst the shingle and pumice floor. Figure 5 shows his principal cross-section through the cave. On the basis of the layering and interpretation of rockfalls, the sequence has been divided into three main occupations. Figure 6 shows a schematic representation of these.

Whenever layer numbers are mentioned, these refer to Hosking's excavation. The three occupations described, however, are a reassessment and grouping of the original layers to allow reinterpretation of layers behind the rockfall and their relationships in the light of the Carbon 14 dates.

The stratigraphy was well defined during the earliest occupation but in Occupations 2 and 3 considerably more lensing and redistribution of floor material occurred making interpretation more difficult.

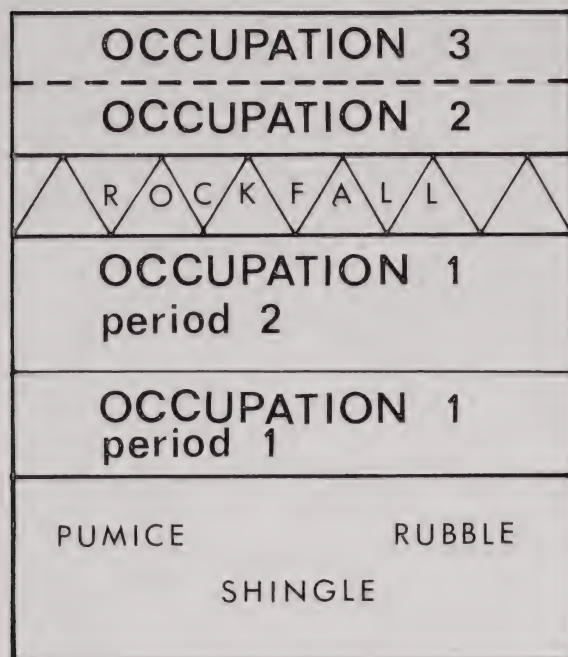


Fig. 6. Schematic representation of cave occupations.

Occupation 1 has been separated into 2 periods. Occupation 1, period 1, represents the initial occupation, Hosking's layers 11 and 10. Cultural material was at first mixed into the soft shingle and pumice surface by trampling and a number of haangi were dug into the rhyolite talus deposits in squares 57 and 56. Occupation continued for a long enough period to allow a hard, black floor to be formed (layer 10) over the beach deposit. The extent of this occupation is shown in Fig. 4.

Occupation 1, period 1, covered a floor space of about 830 ft² (c. 77m²) but only a portion of this was available for use because of the presence of rocks.

Square 46, one of the most significant in the site because of the amount of cultural and midden material it contained, was a working area. Large rocks, especially 26 and 27, would have had tops that were at about waist-height and may have been work-benches, as worked material extended just over the inner side of rock 26, which was in the baulk between squares 46 and 36. This was especially noticeable with the waste obsidian flakes, whose largest concentration was in this area. The obvious place to deposit obsidian waste would have been towards the back of the cave as it would not be advisable to leave the sharp pieces in the living area. However, obsidian flakes were found scattered throughout the other squares as well. This square also contained industrial moa bone and artifacts such as a broken bird spear (Fig. 15), a small pumice adze and a broken bone needle.

Square 56 during Occupation 1, period 1, contained only one large rock and a hard floor was formed on the talus deposit overlying the beach shingle. The position of this square at the cave entrance, the protection it received in the early period from the cave overhang and the fact that it contained little artifactual or

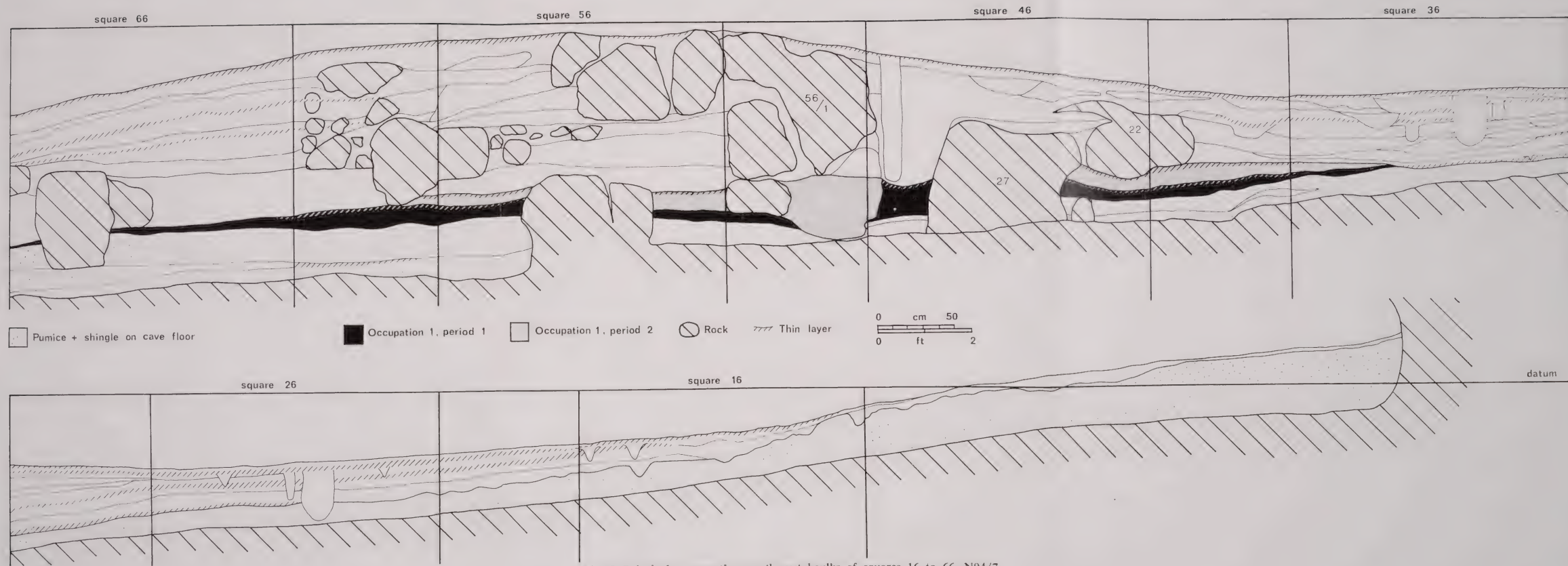


Fig. 5. Principal cross-section, south-west baulks of squares 16 to 66, N94/7.

midden material, suggest that it was a common "vestibule" between the entrance, the working area and the cooking area in squares 57 and 67. A number of haangi, some large, with a number of stones associated with them, while others were just hollow depressions, were situated in this area, near the north-east cave wall. From personal experience, this is the best position for cooking because of the up-draught. Throughout the site description, the term "haangi" is applied to both stone-filled, shallow basins and fire-pit depressions containing charcoal but with no stones closely associated.

Square 45 contained a rock heap but behind this, in square 43, 44 and 47, were rock-free, sheltered portions that could have been used for sleeping. Early occupation material and layers extended into these parts.

Charcoal in a thin, black, cultural layer in square 47 gives a date of 605 ± 56 B.P. (NZ 686A; see below, p.46). An even earlier date (NZ648A) from a haangi from layer 11 was also recorded but is probably not as reliable (see below, p.46).

Occupation 1, period 2, was very similar in pattern to the initial occupation. This represents Hosking's layers 9, 8 and 7 from the cave entrance as far back as the 40/30 boundary baulk line. The cultural material showed little change in type but was less in quantity and varied slightly in distribution. Items such as obsidian flakes and bird bones, although fewer than in period 1, were more abundant in squares 44 and parts of 45 than they had been previously. There is some evidence for either a small roof fall or some rearrangement of rocks on the black floor surface of layer 10, suggesting a time break between the two periods of Occupation 1.

Layer 9 was a soft, black-grey material containing gravel. Layer 8 was similar but rather yellowish and with fewer stones. The origin of these layers was unclear but it may have been partly earth and gravel from outside the cave brought in to level off the floor amongst the rocks. Both layers contained cultural material and were more consolidated in some areas than others. Finally a thin, black, hard floor, layer 7, was formed on the surface of these two layers. This also contained cultural material.

The faunal material, including moa bone, was similar to that of period 1 but fewer animals were represented, except for an increase in the number of *Galaxias*. The number of obsidian flakes dropped considerably during period 2, indicating a change in obsidian collecting and working.

Occupation 1, period 2, layers did not extend quite as far over the cave surface as those of period 1. Charcoal from a haangi in square 57, layer 7, gave a result of 479 ± 55 B.P. (NZ 1030A; see below p.46). Statistically, this could represent the same group of activities as NZ 686A, or there could be a minor time break between the two.

At some period after the deposition of layer 7, the overhang at the mouth of the cave collapsed, spilling some material out to the front of the cave and some to the back, covering most of squares 45, 46 and 47 and those nearer the cave entrance. This heap of rocks formed an irregular, rocky sill at the entrance. Further inside the cave, the rocks were prevented from rolling back by the height and

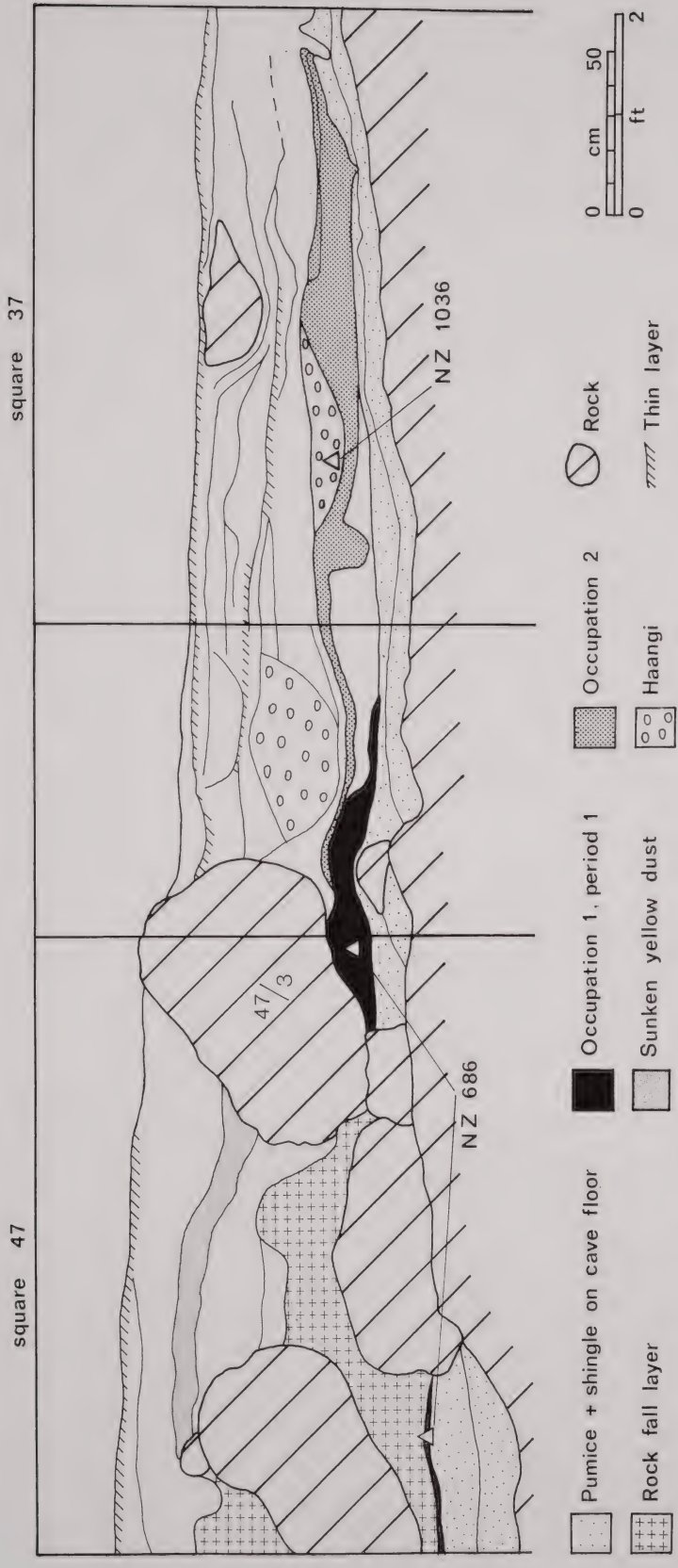


Fig. 7. Cross-section, south-west baulks of squares 47 to 37, showing rock 47/3.

position of rocks 26, 27 and 14. These formed a "dam" at about the position of the 40/30 baulk boundary line. Beyond this line, the back of the cave remained almost as it was originally except for a limited area of occupation 1, period 1, material that extended on to the beach rubble in the front parts of squares 35 and 36.

Tectonic activity or changes in erosion and drainage patterns caused by bush destruction are two possible causes for this collapse.

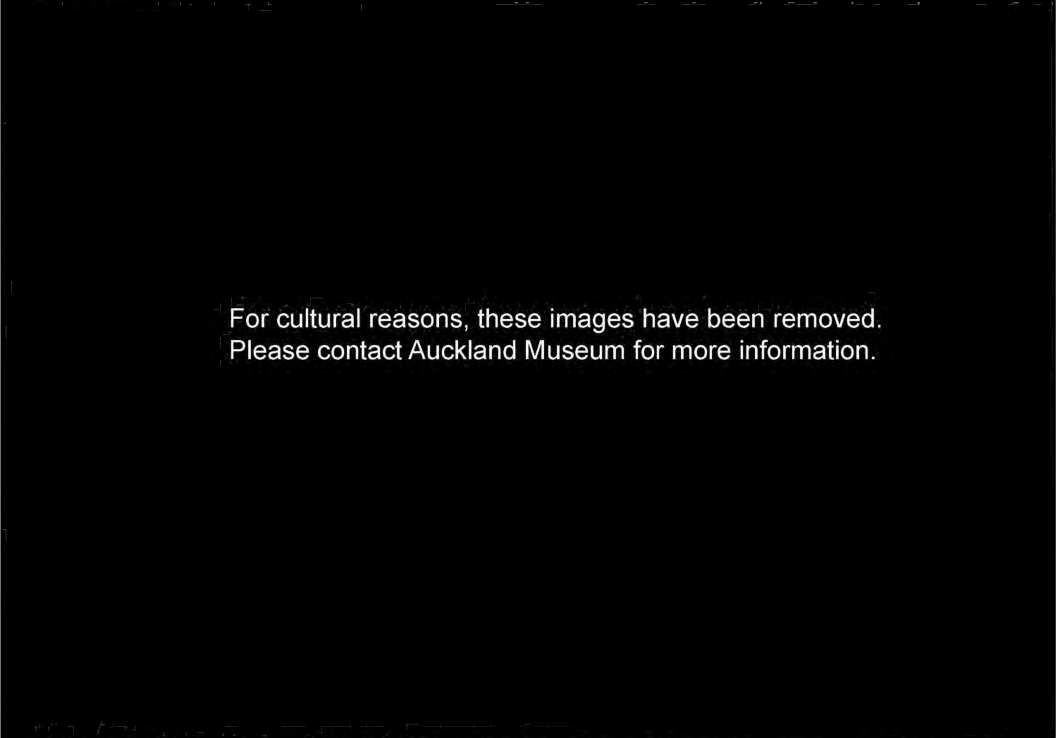
Some time later, a new series of occupations began. These took place behind the irregular rocky "dam" in the area where the cave floor still remained flattish and much as it had always been. The rocky "dam" area would have become more exposed to the elements but the illumination further back in the cave would have been increased, thus making it more acceptable to live in and more sheltered behind the "dam". Subsequent occupations built up layers but Hosking's layers 9, 8, 7, 6 and 5 in this area cannot represent a continuation of pre-rockfall layers because the latter do not continue beyond the "dam".

After the rockfall, at some later stage, rock 47/3 (Fig. 7) which was standing on end, tilted forward covering the yellow-brown Occupation 1, period 1, material in the baulk boundary line 47/37 and allowing the material behind the rock to sag. It is not clear whether this happened before Occupation 2 or soon after. However, the yellow layer into which a haangi was dug rises up towards rock 47/3 but is not underneath it so, clearly, this layer was deposited after the rockfall. The haangi dug into this yellow layer has a Carbon 14 date (NZ 1036A) of 279 ± 55 B.P.

Nearby, another haangi was dug down into the remnant of the Occupation 1 material in square 36 (Fig. 8). Hosking interpreted this haangi as being from layer 10 and the carbon sample was assigned to layer 10. His note on the carbon sample form reads "Recovered from a haangi cut from the surface of layer 10, and deliberately covered with a layer of yellow grit." This sample was dated to 249 ± 59 B.P. (NZ 1029A). These two results, NZ 1036A and NZ 1029A, appear to date the same occupation. A reassessment of the layers and their relation to the rockfall "dam" showed that the haangi in square 36 had been dug *into* layer 10 and that the layer associated with this haangi rose up against the rockfall and therefore must post-date it (Figs. 8, 9). This reassessment of the stratigraphic position of the haangi fits the Carbon 14 dates, rockfall interpretation and layering more satisfactorily than Hosking's original interpretation and places it in Occupation 2.

Later activities behind the rockfall were not easy to interpret. From the beginning of Occupation 2 onwards, layers containing many lenses were gradually built up. Crumbled, yellow rockfall debris, together with earth, midden, humus and charcoal were continually being added behind the rockfall, first to cover the beach deposit, then to level off haangi scoops, build new ones and cover fires and debris.

A charcoal scatter from a layer further back in the cave than the haangi in the south-east baulk in square 36, but still within the same square, was dated as "modern" (NZ 1031A). A rerun of the sample suggested that it was deposited



For cultural reasons, these images have been removed.
Please contact Auckland Museum for more information.

Fig. 8. Square 36, south-east baulk, showing edge of haangi (source of Carbon 14 sample, NZ 1029A) dug into layer 10, to left of ranging pole.

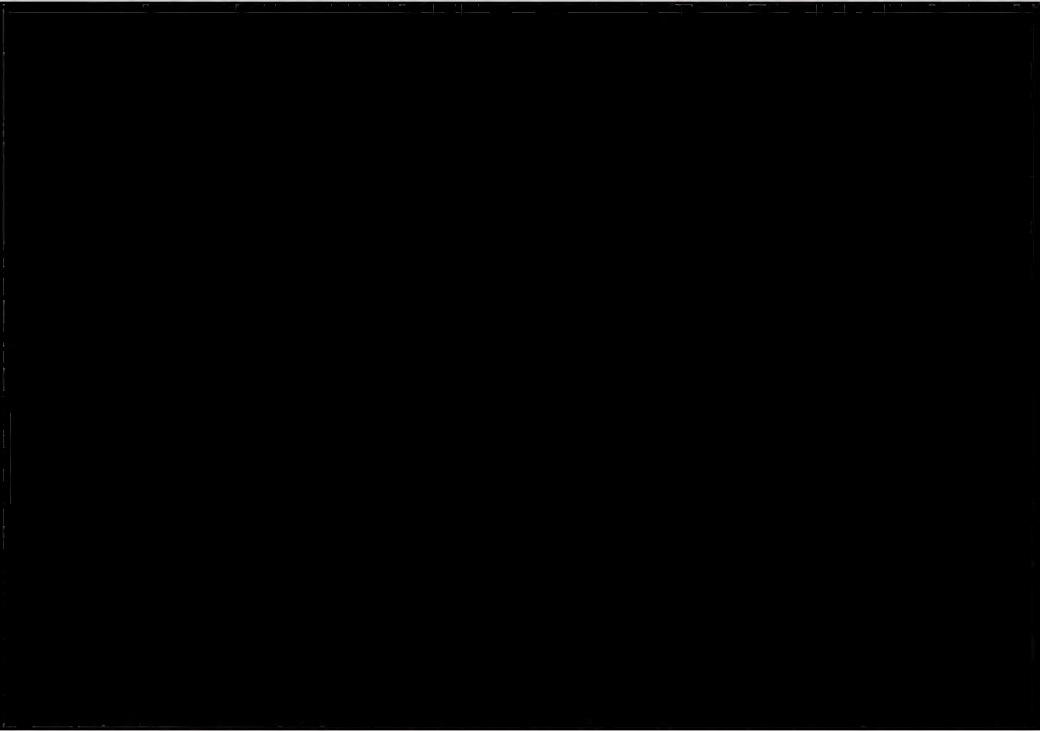


Fig. 9. General view of the cave from square 36, north-west baulk, showing rock 26 (centre) and rock 14 (upper left). Note post-rock-fall layers (north-east baulk) rising up to rock-fall.

not earlier than 205 years before 1950 and is more likely to be from the nineteenth century. Hosking assigned this charcoal scatter to layer 9 but, as it is from the layer stratigraphically higher (that is, later) and further back than the haangi in square 36 and as this layer slopes up to the rockfall, it cannot be a continuation of layer 9 in Occupation 1, period 2.

Hosking noted that a series of hard, yellow patches were laid down at about his layer 4 level (Hosking, 1962, p. 29). These patches do not seem to cover all this layer but they could indicate a floor on which later activities or some changes occurred. The earliest European material (an iron hook) was found in layer 4 and it is likely that this "modern" Carbon 14 date can be associated with the new build-up of layers over this patchy floor. These later layers, associated with increasingly prevalent European artifacts, have been assigned to Occupation 3.

Midden material was thrown into the crevices amongst the rockfall and at some period during Occupation 3 this area was deliberately filled in.

Some suggestions of structures were found in the Occupation 2 layers such as a shallow post hole(?) beneath the haangi in square 37 (Fig. 7) but it was not until Occupation 3 that post and stake holes occurred in any numbers. There was no apparent order to them but they can be assumed to indicate racks, wind-breaks and other structures, including those associated with flax working and weaving (on the basis of the botanical evidence).

The number of birds, especially forest birds, decreased in Occupation 2, but the *Hyridella* (fresh water mussel) numbers increased (Table 1). One or two scraps of moa bone occurred but these were residue from isolated pieces deposited on the beach before the rockfall. Greater activity in obsidian flaking and core preparation is suggested by the number of flakes present and the number of pieces showing some cortex. The proportion and composition of imported sea shells also alters (Table 2) when compared with Occupation 1.

Table 1. Minimum number of birds, *Hyridella* and fish (*Galaxias brevipinnis*?) present in the occupation layers, N94/7.

	Birds	<i>Hyridella</i>	Fish
Occupation 3	10	120	1
Occupation 2	22	42	11
Occupation 1 period 2	37	4	21
Occupation 1 period 1	54	6	9
	123	172	42

Table 2. Minimum number of sea-shell valves present in N94/7.

	<i>Perna</i> sp.		<i>Amphidesma</i> <i>subtriangulatum</i>	<i>Amphidesma</i> <i>australe</i>
	left	right		
Occupation 3	30	3	6	3
Occupation 2	5	1	83	18
Occupation 1 period 2	present	present	10	6
Occupation 1 period 1	1	1	31	nil

During Occupation 3, little bird bone was found but the number of *Hyridella* increased even more than in Occupation 2. Obsidian working remained important. Especially noticeable is the increase in botanical evidence for flax working and weaving right up until the final occupation layer in the cave.

Of the original rocks in the central chamber, only 3 and 14 and just the tops of a few others, remained above the surface by the end of Occupation 3.

RADIOCARBON DATING

Six samples were analysed by the Institute of Nuclear Sciences. The results quoted below are all based on the old half life of Carbon 14, without secular correction, that is they are the dates in the laboratory "A" form.

Sample NZ 648A came from the baulk area between squares 56, 57, 66, 67. The charcoal was selected from a big haangi containing large lumps of charcoal and burnt moa bone. This haangi was the largest in the cave and Hosking considered it to be one of the earliest because of its position in the cave entrance and its relation to the other haangi. It was dug into the rhyolite talus and contained some of the largest ignimbrite haangi stones found in the site. The Carbon 14 date is 1005 ± 57 B.P. (A.D. 945 ± 57). As the charcoal used was from large lumps, and because of the possibility that the early fire had been made from dry, dead timber that could have been in or around the cave at the time of the first occupation, the real age of this haangi is uncertain. Another sample from the same occupation (NZ 686A) from square 47, layer 11, gave a date of 605 ± 56 B.P. (A.D. 1345 ± 56). This charcoal was from a thin, black, cultural layer resting on the pumice rubble and consisted of small, charred twigs. This seems a more reasonable date for the first cave occupation and the sample is more likely to date the actual event because of its composition.

It is possible that the large haangi near the front of the cave could have represented an earlier transitory visit, although the black occupation layer appears to be continuous with the rest of Occupation 1, period 1. A date of A.D. 950. would be within the bounds of possibility given our present knowledge of New Zealand prehistory (Green 1974, p. 29). The Oturehua quarry in inland Otago, for example, is dated to the eleventh century A.D. by two Carbon 14 dates (Leach 1969, p. 72). However, the possibility of the use of relict wood makes the very early date from Whakamoenga questionable and therefore not acceptable until more is known of the archaeology of the inland North Island and the possibility of other early dates occurring there.

Sample NZ 1030A came from an oven in square 57 (layer 7) and was buried by the major rockfall that sealed Occupation 1, periods 1 and 2. It gave a date of 479 ± 55 B.P. (A.D. 1471 ± 55). As NZ 686A and NZ 1030A fall within two standard deviations of each other they could date the same occupation but other evidence suggests that two periods can be recognised before the large rockfall. NZ 1030A was also stratigraphically later than NZ 686A so that these carbon dates appear to be separated by a genuine time interval, even though not of great length. The material culture and the midden material do not indicate a qualitative change but rather a change in amount, quantity and distribution.

Sample NZ 1036A, from square 37, dated 279 ± 55 B.P. (A.D. 1671 ± 55) and NZ 1029A, from square 36, dated 249 ± 59 B.P. (A.D. 1701 ± 59) are considered to be from the second major occupation, which occurred further back in the cave some time after the major rockfall (Figs. 7, 8). These dates are within one standard deviation of each other and probably represent aspects of the same occupation, that is, the first post-rockfall accumulation in the back part of the cave.

Sample NZ 1031A from the north-west baulk in square 36, was from charcoal intermixed with stony, yellow-black material which formed a compact floor. It gave a "modern" date. The sample was rerun by the laboratory and the result (less than 205 years B.P.) supported the original assessment. This sample has already been discussed above (pp.43,45). By the time layer 3 was deposited, muskets were being used, so that a nineteenth century date is quite acceptable for the upper layers.

With the reassessment of the Occupation 2 and 3 layers as being deposited after the rockfall, the Carbon 14 dates which originally seemed anomalous (especially Hosking's layer 9 from square 36) now present a consistent sequence through time and show that Whakamoenga Cave had a long occupation history.

FAUNA

Birds

Dependence on bird hunting in Occupation 1 was evidenced by the number of species present (Table 3). Bush birds were the most common, followed by water birds. Birds from other environments were present but not in significant numbers. Moas were hunted.

The method used to ascertain the minimum numbers was that described by Law (1972, p. 96). This was satisfactory for the Occupation 1 material, where the various species can be assigned to separate layers but during Occupation 2 and 3 the layer distinction is not so clear. A certain amount of cultural material and bone came from deposits probably thrown out amongst the rocks in the front of the cave after the rockfall but before the area was filled in.

Occupation 1, period 1, produced the greatest number of birds, followed by Occupation 1, period 2. Occupation 2 showed a drop in numbers, especially in bush birds, although water birds remain in about the same proportion as Occupation 1. This would suggest that bush birds were harder to obtain, or else less desirable, with the former suggestion more likely. The destruction of the bush in the environs of the cave catchment area probably accounts for their decline.

In Occupation 3, birds become insignificant, except for tui and kaka. Cooper (1851) talks of potted birds, including kaka, at the feast at Pukawa in 1850 (see above, p. 36), and their continued presence in Occupation 3 may be associated with this process. Present in this bone material were wing and head bones, including the ramus of a mandible, suggesting that whole birds had been brought to the cave. However, Downes (1928) recorded that beaks were sometimes tied on to gourd containers to show which species was inside, so the mandible may indicate the presence of potted birds.

Table 3. Minimum number of birds present in site N94/7, by occupation periods and habitat.

Name	Occupation period 1	Occupation period 2	Occupation 2	Occupation 3
BUSH				
Tui				
<i>Prothemadera n. novaeseelandiae</i>	20	10	3	2
Parakeet (red-crowned)				
<i>Cyanoramphus n. novaezealandiae</i>	12	7	1	—
Parakeet (yellow-crowned)				
<i>Cyanoramphus auriceps</i>	3	4	—	—
Kaka				
<i>Nestor meridionalis septentrionalis</i>	2	3	3	3
Pigeon				
<i>Hemiphaga n. novaeseelandiae</i>	2	3	1	1
Wattled Crow				
<i>Callaeas cinerea wilsoni</i>	1	1	—	—
Kakapo				
<i>Strigops habroptilus</i>	1	—	—	—
Saddleback				
<i>Philesturnus carunculatus</i>	—	1	—	—
Kiwi				
<i>Apteryx sp.</i>	1	—	1	—
N.I. Tomtit(?)				
<i>Petroica macrocephala(?)</i>	—	—	1	—
LAKE/RIVER/SWAMP				
Southern crested Grebe				
<i>Podiceps cristatus australis</i>	1	2	1	—
Duck, small				
<i>Anas sp.</i>	2	1	3	—
Duck				
<i>Anas sp.</i>	1(?)	—	1	—
Grey Duck				
<i>Anas superciliosa</i>	1	—	1	—
Heron-like Bird				
Family Ardeidae	—	1	—	1
Scaup				
<i>Aythya novaeseelandiae</i>	1	1(?)	1(?)	—
Rail, small				
<i>Rallus sp.</i>	1	—	—	—
Banded Rail				
<i>Rallus philippensis</i>	—	—	1	—
Extinct Coot				
<i>Palaeolimnas chathamensis</i>	1	—	—	—
Shag, small (pied or black)				
<i>Phalacrocorax sp.</i>	—	1	1	—
Shag, large				
<i>Phalacrocorax sp.</i>	1	—	—	—
Dabchick				
<i>Podiceps rufopectus</i>	—	—	—	1
SCRUB/BUSH EDGE				
Weka				
<i>Gallirallus australis</i>	1	1	—	—
Extinct Quail				
<i>Coturnix novaezealandiae</i>	1	1	1	—
SEA/COASTAL				
Gull, black-billed				
<i>Larus bulleri</i>	1	—	1	—
Petrel				
Petrel sp.	—	—	1	—
Shag, spotted				
<i>Stictocarbo p. punctatus</i>	—	—	—	1
Gannet				
<i>Sula bassana serrator</i>	—	—	—	1
	54	37	22	10

By the time the first Europeans visited Taupo, there were practically no forest stands left in the vicinity of the lake and therefore few bush birds. Waterfowl were mentioned as plentiful, especially ducks. The nearest forests to the cave would be at Mt Tauhara, Opepe, Oruanui and Mokai, all of them, except possibly Mt Tauhara, over a day's journey away.

Tuis were the most common bird in the site but, like other bush birds, their numbers drop off in the later occupations. However kowhai and flax would attract them in the spring even if little forest was present.

Next in importance were the red-crowned parakeet (*Cyanoramphus novaezealandiae*) and yellow-crowned parakeet (*Cyanoramphus auriceps*). These birds are generally associated with podocarp and/or hardwood forest. However, recent work by Taylor (1975, pp. 114-6) suggests that the two species may have distinct habitats. This difference probably had a significance for their hunting during the early period, as it is the red-crowned parakeet that dominates the parakeet numbers. Taylor states (1975, pp. 114-5):

Little is known of the ecological factor keeping red-crowned, yellow-crowned and orange-fronted parakeets apart on the New Zealand mainland, but marked differences certainly occur. Field observations suggest that the yellow-crowned parakeet is adapted to forest habitats, whereas the red-crowned parakeet is a bird of more open country and forest margins.

Dieffenbach (1843, I, p. 58) talks of parrots (Kakariki) raiding potato gardens and berries that grew in open and cultivated spots on the ground. The species name he used has since been changed to *Cyanoramphus novaezealandiae* (S. Reed, pers. comm.), that is, the red-crowned parakeet.

Thus the tui and the red-crowned parakeet, which eats mainly vegetation and flowers, would probably be occupying similar territories.

Water birds were fairly evenly distributed throughout Occupation 1 and 2. The nearest suitable habitats would be at the swampy mouth of the Waikato River and across Tapuaeharuru Bay at the Rotongaio lagoon, as the exposed rocky cave foreshore would offer little protection or food for these species.

Although the early travellers talk of the large numbers of ducks, they do not figure substantially in the total bird remains. The presence of the southern crested grebe (*Podiceps cristatus australis*) is interesting as it is no longer found in the North Island. A breeding population must have been present on the lake up to the Occupation 2 period.

Evidence for the extinct coot (*Palaeolimnas chathamensis* Forbes) was found in Occupation 1, period 1. This bird was also present in layer 5 at Hot Water Beach (Leahy 1974, pp. 60, 64) so its presence both on the coast and inland suggests that it was widely spread in early times.

Although the presence of "sea birds" in the cave is not unusual, some of the birds (or bones) must have been carried inland. The black-billed gull (*Larus bulleri*) tends to be an inland resident, especially in the South Island. There are breeding colonies on Lake Rotorua at the present time. Some petrels nest inland and "mutton birds" were collected from certain areas in Taupo in early times

(Hosking, pers. comm.). Two anomalies are the spotted shag (*Stictocarbo punctatus*), represented by a part shaft of a right radius, and the gannet (*Sula bassana serrator*), represented by a left quadrate. Both came from Occupation 3. These two birds are definitely sea-shore animals.

The radius of a shag is a long, thin bone and its presence in the cave might suggest its use for needle or tool-making of some sort. Hamilton (1896, p.174) describes a Maori kete (basket) found near the Upper Taieri in the South Island. It contained a number of items amongst which were "two bones from the wings of an albatross, cut off neatly at each end and prepared for flutes; the holes, however, were not bored." Whether potential flutes or not, these long wing bones performed some function and were part of what seemed to be a "travelling kit" of a Maori woman. Other evidence from its contents is discussed below (pp. 53, 54).

Little can be said of the gannet head bone and its presence and possible use are inexplicable.

The numbers of body bones as well as head, wing and lower leg bones of various birds do not indicate preservation on the site, nor do they suggest that butchering was carried on outside the cave environs. One interesting group of remains came from square 67, Occupation 1, period 1 (layer 10). These consisted of a fragment of sternum, the proximal end of a right ulna, the right tibio-tarsus, the right tarso-metatarsus and the proximal end of a right femur of a pigeon. Square 67 was one of the "cooking areas" in the early period. These bones could represent a cooked pigeon split in half and might be one person's portion.

No immature bird bone, except moa, was found in any of the layers. As most birds nest from September to February and many have two or more broods a season, it could suggest that the cave was occupied at a time when most birds had matured. Shortland (1854, p. 198), talking of the upper Wanganui, states:

About the month of June, a great part of the population migrate to the immense forests lying between their river and the more central parts of the island for the express purpose of catching parrot. Every evening the birds taken during the day are roasted over fires and then potted in calabashes in their grease, for they are very fat. Thus preserved, parrots and other birds are considered a delicacy, and are sent as presents to parts of the country where they were scarce.

This indicates that hunting parties were not deterred by weather conditions inland when some foods were desirable.

Although Taupo winter temperatures and the southerly aspect of the cave would not appear conducive to spending a winter period in the area, the evidence indicates that the birds caught were all mature (except for the moa) and therefore probably captured during the autumn, winter or early spring months.

The cave's dry, sheltered interior, its strategic position in relation to the exploitation of the lake environs, the presence of some important commodity or commodities that required visits to the area and the number of haangi and fire-pits might well indicate winter occupation, especially during the earlier periods.

Commodities such as birds, which feed on podocarp fruits in the autumn and winter; fern root, which was best gathered after burning off in July and August¹; inanga, which swarmed in the lake between August and September, and crayfish and *Hyridella*, available all the year round, could have supported a group for several months and all these items are ethnographically recorded as having been dried or preserved in the area.

Ample food supplies and adequate shelter could make the cave a very useful camping place during the winter or early spring. Although the Whangamata obsidian would be available throughout the year, this season, because of the food resources, might be a suitable one in which to collect this commodity as well.

Moa

Moa bone was present in the cave during Occupation 1. These birds were used as food and bone for industrial purposes. Charred bones were found associated with haangi. The presence of claws, tracheal rings and pelvis indicated that whole birds were brought to the cave intact, although no head bones were found.

Positively identified are *Euryapteryx curtis* and an immature *Euryapteryx exilis*. Almost positively identified also is *Euryapteryx geranoides* (G. Mason, pers. comm.). Other bones could represent *Euryapteryx geranoides* or *Pachyornis mappini* and *Euryapteryx curtis* or *Anomalopteryx oweni*. At least three species of moa seem to be present in the cave deposits with a minimum of four birds, one of which was immature.

At the base of the rock ledge at the baulk extension of square 43, resting on the pumice rubble, was a heap of egg shell identified as moa (R. Scarlett, pers. comm.). Little is known of moa breeding patterns and the length of time before a bird became fully mature, but it is possible that an egg could be gathered during the nesting period and a young, immature bird from the season before caught at a similar time.

These birds were probably forest-dwelling (Simmons 1968) and, as practically no moa bone was found in the later occupations except for a few scraps apparently dug up from the early layers by haangi activity during Occupation 2, it may be that destruction of the forest affected their ability to survive in the area.

Shellfish

Shells were common and scattered throughout the layers. They were of two types, fresh water and marine. Apart from one small fresh water univalve (*Potamopyrgus antipodarum*) from Occupation 2 which could have been introduced attached to any lake material brought in, all the fresh water shells were the bivalve *Hyridella menziesi*, or kakahi.

These shells were sorted into left and right valves where possible, and the number of right valves used to record the numbers of animals present (Table 1). Layer 10 had only left valves so this group was included. There was also a considerable number of broken pieces of shells in all layers.

¹Colenso (1880, p. 3) and Cassels (1972, p. 24) suggest that fern root was at its most abundant from August until January.

Although the samples are small, it is still possible to suggest some trends in the *Hyridella* distribution. *Hyridella* were not important during Occupation 1 but in Occupation 2 and 3 they increased markedly. Their increase tends to be in inverse relationship to the number of birds present. These shellfish are not considered very palatable these days but they were once a readily available source of protein requiring less effort to obtain than birds and probably fish. Parmalee and Klippel (1974, p. 432) suggest that North American fresh water mussels are not particularly high in food value and contain fewer calories per unit than most other meat animals so that their use would be supplementary rather than staple. However, the ease of collection could balance their lesser food value. This might not apply to the collection of shellfish in Lake Taupo as the beds are usually off-shore and below about 1.8 m of water in most places but dredges could have been used. Collection from rivers and streams would be easier but there are no such places nearer to the cave than the Waikato River or the Rotongaio Lagoon. *Hyridella* will remain alive for at least a week if kept moist, as I have found from personal experience, and these animals could have been so treated during a foraging trip of a few days. The increasing numbers in the later occupations suggest that there was more pressure on animal food resources once the bush had been destroyed.

The *Hyridella* shells, although they have a thick lip along one side, generally do not appear to have been used as scrapers or tools except in a few cases. One shell from Occupation 1, period 1, had a semi-circular groove filed into the lip to form a tool, possibly a scraper for removing bark or some similar activity and one or two shells showed wear-flaking along the lip edge. The thick portion of a *Hyridella* shell from layer 3B at Hot Water Beach had been formed into a fish-hook (Leahy 1974, p. 37) but in general these shells do not seem to have had the qualities necessary for tool-making.

The average length of shells in the cave was between 5 and 6 cm. The smallest was 3.4 cm. Comparisons with modern populations (from the Parau Dam, Auckland and Pukawa, Taupo) show the size of the smallest shell collected was 3.0 cm from Parau and 2.3 cm from Pukawa, so it may be that the cave shells were being selected and very small ones were not being carried to the site.

In contrast to the food potential of the *Hyridella*, a large number of marine shells present appear to have been used as maintenance and/or extractive tools (Binford & Binford 1969, p. 71). The majority of these shells were tuatua (*Amphidesma subtriangulatum*), pipi (*Amphidesma australe*) and the green mussel (*Perna canaliculus*). These shells were brought into the cave as individual items, not as pairs of bivalves associated with food and so have been assessed as single items.

Table 2 shows the distribution of sea shells in the cave.

The *Amphidesma* shells showed heavy wear-flaking round their edges and practically all are broken suggesting their use as scrapers of some sort.

Perna (green mussel) shells seem to have been general purpose tools; as well as their use for fibre scraping they could have served as cutters, bark removers, containers, spoons or scoops for water or earth and other activities. No *Perna* shells were complete. Two showed evidence of use as kokowai containers in Occupation

3. The later increase in *Perna* shells probably corresponds with the increased evidence for flax and fibre working in the same occupation.

From limited study, the type of wear-flaking and edge damage caused by stripping the epidermis from flax with *Perna* shells appears to differ from the type of wear-flaking on the *Amphidesma* shells (unless this results from the physical difference between the shells) but it is still possible that *Amphidesma* shells were also used to strip flax or bark.

Another possible use of *Amphidesma* shells is in scraping fern root. Best (1942, p. 98) makes an interesting comment on fern root preparation:

There is little to add to the description of the very simple method of cooking the roots [fern root], save that only a few of the accounts recorded mention the scraping process after the roasting or heating at the fire, and prior to the beating or pounding of the root; the scraping removes the black inedible bark-like outer substance of the root, usually with a shell.

Most writers, such as Banks (Beaglehole 1962, 1, p. 416), Cook (Beaglehole 1955, p. 585) and Buck (1952, p. 85) do not mention this shell scraping process. Some scraping activity increased in the cave during Occupation 2, and it could be postulated that this might indicate more dependence on fern root and the scraping with shells during its preparation. The number of *Amphidesma* shells increased tremendously during Occupation 2, at a time when most of the bush had probably been burnt off, but before the land had become infertile, as Bidwill described it, after countless fern and scrub burnings.

Byrne's (1973) analysis of human coprolites from the cave suggests the consumption of fern root during Occupation 2 and 3. Appendix 1 (below) shows the plant identifications and proportions of bracken rhizome remains in the coprolites studied. Coprolites from Occupation 1 show no indication of the presence of this root but some from square 34, layer 7 and those from Hosking's layer 5, both assigned to Occupation 2, give definite evidence for fern root consumption. Occupation 3 material indicated that fern root was still an important part of the diet but Byrne (1973, p. 80) comments on the coarseness of the plant material in the "late" coprolites, due mainly to the large pieces of rhizome fibre. It is interesting to note that the number of *Amphidesma* shells decreased during Occupation 3 and this, together with Byrne's hypothesis that these roots were no longer being as carefully processed before eating, adds to the evidence that one use for these shells may have been in some aspect of fern root preparation.

Table 2 shows an interesting dichotomy between left and right *Perna* valves, with a definite preference shown for the left. Discussions with Maori women and perusal of the literature suggest that, generally, the left valve is preferred for flax scraping because of the handling shape of the shell (see also Mead 1969, Figs. 75a, b).

The contents of Hamilton's Taiere kete (1896, p. 175; and above) included dressed flax, various fibre articles, feathers, a fragment of flax whitebait net and several *Mytilus* shells which had been used for scraping and preparing flax. The *Mytilus* shells have since been identified as *Perna canaliculus* and all three show staining by red ochre pigment, so that their direct association with flax scraping is in doubt (S. Park, pers. comm.). However, Park suggests that once they had



Fig. 10. Left valves of *Perna canaliculus* compacted one inside the other, from square 57, layer 3.

been broken and were no longer useful for scraping, their use might have changed. The shells are all left valves and from the measurements given could well have fitted one inside the other. D.24.581 measures 14.5 cm and 582, 13.5 cm; 585 was too broken to measure but appears smaller. Fig. 10 shows how similar shells from Whakamoenga fit inside one another and could form a compact part of the travelling equipment for a person. They could have been multi-purpose tools or just used for fibre scraping, as is suggested by the botanical remains in Occupation 3. Right valves have similar properties but were not preferred. The number of left valves is almost certainly indicative of fibre working in Occupation 3.

Dentalium nanum shells were also present, three from Occupation 1, period 1, and one from Occupation 1, period 2. Hosking's artifact record book also mentions seven pieces from Occupation 2, squares 45 and 35, layer 5, but no trace of these has been found amongst the material.

One unusual shell was a complete left valve of *Spisula aequilateralis*. It was found in Occupation 1, period 2, (square 57, layer 8). It appeared to have been unused and showed no edge wear or damage. A. W. B. Powell (pers. comm.) states that it is a deep water bivalve and not used by the Maoris for food. It could have been used as a small dish or scoop.

Fish

A number of small fish bones were found in the various layers (Table 1). These have not been fully identified as to species but compare well with the *Galaxias* species found in the lakes and local streams of the area (A. B. Stephenson, pers. comm.).

According to McDowell (1970) the most common of the Galaxiid fish in the Taupo area is *Galaxias brevipinnis*. A specimen that had previously been preserved for internal dissection was obtained. The preserved length was approximately 170 mm but reservations must be made about this length because of its previous treatment. This specimen was dissected for the comparative bone material, as none appeared to be available elsewhere.

McDowell (1970, p. 365) mentions that the greatest length of these fish previously recorded was between 213-240 mm but the average size was between 160-185 mm, indicating that the dissected fish was within the average size range. The netting found in Occupation 3 in the cave had a mesh measurement that would catch fish about this size but let smaller fish escape, although other ways of catching *Galaxias* are recorded in ethnographic literature.

A variety of bones were present in the layers including vertebrae but the head bones were the most easily identifiable. Of those the "fan-shaped" operculum bone was the most common with the pre-operculum and the jaw bones following. It was assumed that these head bones were from *G. brevipinnis*, although most of them were larger than those of the dissected specimen. The size difference may reflect a more suitable environment in prehistoric times, under-exploitation or the use of a net mesh that allowed smaller fish to escape.

Galaxias brevipinnis inhabits a variety of river and lake systems in New Zealand but the Taupo population appears to be largely lacustrine, living in the almost closed system of the Taupo lakes and their tributaries. Elsewhere it may be one of the types that have migratory juveniles (inanga or whitebait) but the Waikato river is the only outlet to the sea and the Huka falls and Aratiatia rapids form a barrier to most fish migration so that most Taupo juveniles swarm within the lake and up its tributaries alone. The inanga hatch by the shores of the lakes and stream mouths during the early spring and, later, some migrate up the various streams.

Grace (1959) devotes a whole chapter to the native fish at Taupo. He says there are no eels in the lake (and no evidence for these was found in the cave) but, in the past, hosts of small fish were seen in great shoals and provided the Maori of those days with an inexhaustible supply of food. Fish in the lake were caught in several different ways, the most common way being by means of a basket net called a pouraka. Grace (1959, p. 510) describes its construction and use (see also Buck 1921 for the various fishing methods in Lake Rotorua). Buck's descriptions probably form the basis for Grace's discussion of fishing methods in Taupo.

Bidwill (1841, p. 54) says that the Maoris told him there were no fish in the lake except those he saw, which were not more than an inch long. They had vast quantities of these dried in baskets which they cooked by making some sort of soup. Possibly the reason that Bidwill saw no larger fish was because the adults tend to spend their lives in small cold, rapidly flowing, rocky streams which are heavily overgrown with bush.

As well as these fish and *Hyridella*, fresh water crayfish (*Paranephrops planifrons*) were plentiful in the lakes and streams. Grace states that these were caught by placing bait inside a mass of fern branches or similar material and leaving it on the lake bottom. Later, it was carefully raised and the entrapped crayfish captured. Crayfish could also be caught by poking a stick into their holes at the sides of streams and, when the stick was seized by the animal, it was carefully withdrawn with the crayfish attached.

Evidence for the presence of crayfish occurred in the cave but the remains were so fragile that they could not be preserved for definite identification. One claw was found in square 48, Occupation 2.

Rat

Rat bones were present in all layers. A sample of these examined by B. F. Leach exhibited a wide size range (Leach, pers. comm.). A few appeared to be outside the range of the kiore or Polynesian rat (*Rattus exulans*) and might well be the European rats, *R. rattus* or *R. norvegicus*. The coefficient of variation is consistently higher for the cave sample than in other collections examined and Leach thinks this probably represents a breeding population.

Leach suggests that "In New Zealand the maxillary tooth row measurement appears to be substantially larger than elsewhere in Polynesia, and there the largest figures are, interestingly, from marginal Polynesia. I mention this because your series from Whakamoenga Cave is the largest recorded that I know of." Leach's work on the Polynesian rat is only tentative because of the small populations he has to work on. As he suggests, the position of the Polynesian rat, and rats in general, is full of confusion, plagiarism and ambiguity.

A few very small bones from the post-European layers could represent mouse bones and there are a few bones of a larger rat, possibly *R. norvegicus* also in the upper layers. One anomaly is from square 67 Occupation 1, period 1, (layer 10) where rat bones beyond the size range of *R. exulans* occurred. Hosking found no evidence of rat burrows in the cave but a rat could penetrate without leaving traces, along the sides of some of the rocks and crevices before the final filling in of the rockfall during Occupation 3. Atkinson discusses the behaviour of the three types of rat present in New Zealand and states that *R. norvegicus* is a burrowing animal (Atkinson 1973). The presence of unidentified Cucurbitaceae seeds (pumpkin, squash, melon, cucumber etc.) in the same square but in layers 7 and 9, Occupation 1, period 2, and Cooper's (1851) description of the gardens at Pukawa where pumpkins and melons were growing might suggest that similar plant fruits were taken to the cave and the seeds carried by a burrowing rat into the lower layers. These later European times would fit into Cooper's description and Atkinson's estimation of the possible arrival of the burrowing *R. norvegicus* in the North Island (Atkinson 1973).

There is no evidence for human consumption of kiore in the cave. The bones were well scattered and none was charred. Head bones were as common as body bones. A number of matai seeds were present in all layers and all these had been gnawed at their tops and the kernels removed. The seeds suggest that there were matai trees growing near the cave and that these were exploited by rats rather than by humans. Although this latter possibility cannot be ruled out, there are too few seeds per occupation to suggest that the fruit represented a useful food.

During the excavation, a morepork (*Ninox novaeseelandiae*) visited the cave regularly for cave wetas. A bird of this kind could have accounted for some of the rat bones in the cave as rats form part of their diet. Possibly the tentatively identified North Island tit bones in Occupation 2 may also be the result of a similar meal as it is a rather small bird for human consumption. Other rat bones could have come from the natural deaths of a breeding population through time, although some may have been utilised by humans for food.

Tuatara (*Sphenodon punctatus*)

At least one tuatara is represented in Occupation 1, period 1. Occupation 1, period 2, contained cranial bones, vertebrae and part of an immature right radius so that at least two of these animals were present in Occupation 1 as a whole. The other bone found, a right radius, was from Occupation 3 (square 67, layer 3). Crook (1975) has recently shown that the tuatara was formerly widely distributed on the main islands of New Zealand. The interpretation of tuatara remains in archaeological sites is still complicated by the possibility of Maori transfer of animals over considerable distances as pets as well as potential food. This was so with the dog and might also be the case with the tuatara.

Dog

Some dog bones were found in Occupation 1, both periods, and the rat-gnawed right ramus of a mandible was found in Occupation 3 (layer 1). Occupation 2 lacks dog bones, although the animal may have been present then and left no trace.

Human remains

Apart from two pieces, all the human bone occurs in Occupation 3. The majority are skull fragments (Appendix 2, below). Of the two earlier pieces, one from Occupation 1, period 1, (square 46, layer 11) appears to be a portion of the extremity of a long bone. It might be part of a bone from a child but its origin cannot be stated with certainty. Its proximal end is charred. The other piece, probably of human origin, has been cut or broken across the top of a long bone and shaped into a chisel-like edge by cutting the bone edges and then polishing the upper and lower sides. P. M. Reeve (pers. comm.) comments that the trabeculae on the under-surface have not been crushed sufficiently to indicate the upper portion being held in the hand or fingers for any length of time, yet the edge appears to show use polish.

The presence of nothing but skull material in the upper deposits of the cave is curious. There are several small caves along the old 110 foot (33 m) lake level in the vicinity that were once used as burial caves but as far as Hosking could ascertain Whakamoenga Cave was never used for this purpose.

Pig

Pig bones occurred in Occupation 3 and this is consistent with ethnographic records. One bone was a scapula that had been worked and modified into a scoop-like object. Although Elder (1962, p.10) makes little comment on the presence of pigs in the Kaimanawa Ranges, which he says are too high for them, Bidwill (1841) mentions their availability in the Taupo and Rotorua region in 1839.

BOTANICAL EVIDENCE

Evidence of plants was present in most layers and included branches, twigs, bark and seeds as well as woven and man-modified plant material. A collection of woven and worked fibres was found in the dusty surface layers of Occupation 3 in a small cleft between rocks 4, 5, 6, 7 and 8 in square 24. This collection included portions of cloaks, netting, prepared flax and other plant material. The majority of botanical remains came from Occupation 3.

Three types of fibre working (mainly flax) occurred in the site. One was the use of strips of unprepared leaf for baskets, mat and net making. Another showed some scraping and removal of the epidermis and finally there was the carefully prepared muka or flax fibre.

Portions of at least two nets (A.R. 5807 and A.R. 5819) were found in this collection. One was fairly worn and had a mesh size of 30 mm, the other appeared less worn and had a mesh size of just under 30 mm (Fig. 11). A third fragile net portion (A.R. 5758) came from Occupation 3 (square 33, layer 3). This had a mesh of 15 mm. This size would probably have been suitable as a white-baiting net, the mesh being about as small as it would have been possible to make from raw flax strips. The larger mesh nets were of a size suitable for catching bigger *Galaxias* but would let small fish escape. The netting knot is the same as that described by Buck (1926, p. 605).

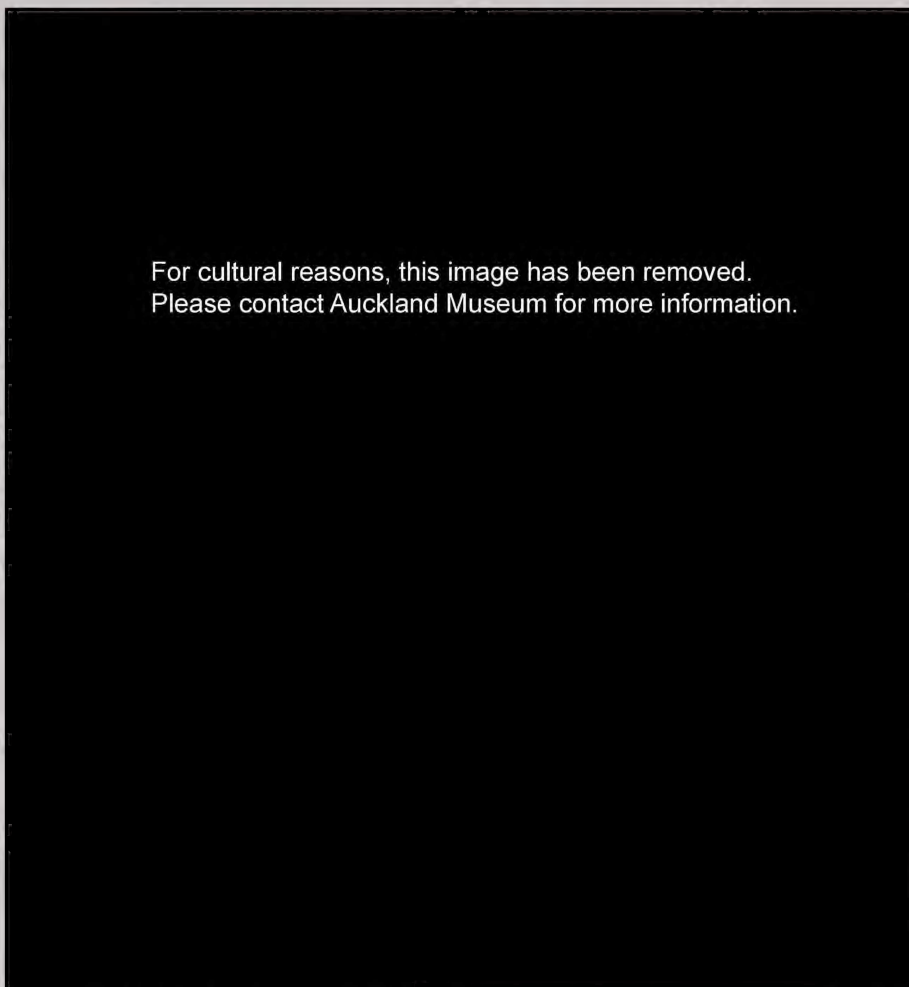
Of the cloaks, none was more than a remnant and they were in a very fragile condition. Three different types were represented. One was Mead's "T" class (Mead 1969, pp. 57, 114), a korowai cloak with rolled fibre tags of the same colour (A.R. 5771). The weft is double pair twining with about 2 cm between wefts. Another was of a similar type but was made from fibre dyed a dull red with red rolled tags (A.R. 5772). A third (A.R. 5772b) was of a coarser weave with wider spaced wefts that were of single pair twining. A considerable amount of leaf epidermis was present and this cloak was probably what Mead (1969, p. 58) describes as M-class, M.1, maimuka with widely spaced wefts.

These artifacts from Occupation 3, square 24, together with a number of flax and other plant material knots, loops, food basket remains, plaited kete edges and other worked pieces rested on a layer of bracken fronds. Other fibrous material included cabbage tree leaves (*Cordyline australis*) and *Astelia* leaves were also present (J. Goulding, pers. comm.).

Three items amongst this collection indicated post-European influence. One was a number of pieces of coarse knitted woollen yarn, possibly heavy sock or woollen stocking (J. Smith, pers. comm), that had a few black hairs about $\frac{3}{4}$ inch (ca.

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Figs. 11-13. Fibres. 11. Flax netting from Occupation 3 with mesh size of just under 30 mm. 12. Scraped flax epidermis from Occupation 3. 13. Three-ply plaited cordage from Occupation 3.



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Fig. 14. Gourd lip with stamped and incised decoration, Occupation 3, square 24, layer 1.

19 mm) long attached to them. This could have been horse hair (not positively identified). Another European item was a strip of red cotton material and the third a small piece of twisted sisal fibre (*Agave sisalana*).

Evidence for flax working, especially in Occupation 3 was represented by strips of flax epidermis (Fig. 12). A few pieces of this also occurred in Occupation 2. Flax in both these occupations was also used for binding and cordage. The cordage was mainly 3-ply plaiting (Fig. 13). Occupation 1, period 2, produced no evidence of flax working but a small, very neat and partly burnt piece of flax plaiting was found in Occupation 1, period 1 (square 36, layer 10).

Numbers of pieces of gourd (*Lagenaria* sp.) were present. Some were kokowai covered. In Occupation 3 (square 24, layer 1), a collection of pieces was found that had been carefully lashed to other pieces after the gourd had been broken. This poses the question of what was stored in a gourd receptacle, once broken, although it is possible that the mend could be made water tight. Also from the same square was the neck, or lip portion, of a gourd with a stamped and incised strip of decoration (Fig. 14). This form of decoration on gourds is not known from anywhere else

in New Zealand (D. Simmonds, pers. comm.) but, as it comes from a post-European layer, the design might not be typically Maori. It may, however, represent a style that had long since gone out of fashion elsewhere, such as that found on woodcarving by Cassels (pers. comm.) at Waitore (N136/16), near Patea.

In Occupation 3 (square 67, layer 2) near the mouth of the cave the stem and top of an immature gourd were found, indicating that these "vegetables" were probably being used as food. Colenso (1880, p.15) states that the gourd was a "... prized and wholesome vegetable food (or rather fruit) during the whole of the hot summer days while it lasted and before their kumara were ripe for use..." Cooper (1851) does not mention gourds growing at Pukawa but they might well have been there, although young gourds could have been brought in from anywhere.

Some small charred pieces of gourd were found in Occupation 1, period 1, so the use of gourds was a feature from the earliest times in the cave.

Bracken (*Pteridium esculentum*) was used in all occupations; probably for bedding and for fire lighting, as many of the stalks were partially burnt. The stalks were also used for artifacts, as one piece in Occupation 3 (square 24, layer 1) was bent into a loop and bound with *Cordyline*.

Evidence for the use of bracken rhizomes as food in Occupations 2 and 3 has been discussed (see above). There is no direct evidence for its use as food during Occupation 1 although it seems likely. Byrne, however, states (1973, p.12) that "the coprolites [that he examined] from the early levels contained very pulpy material, possibly the residue of berries or a root crop such as kumara, those from the later levels contained quantities of bracken fern rhizome." It seems doubtful whether kumara was ever grown in the Taupo area, so that his pulpy material may have been partly due to consumption of softer vegetable material than fern root. However he examined only a sample of the 138 coprolites found and the absence of fern root fibres in Occupation 1 may be due to sampling error.

Karaka seeds (*Corynocarpus laevigatus*) occurred in Occupation 3 and a possible seed case was found in Occupation 1, period 1 (square 46, layer 10). At present there are a few remnant trees standing at Jerusalem Bay but it is doubtful whether these trees are of any great age. They could, however, be a possible source for the Occupation 3 example.

A list of identified plants from the cave is given in Table 4, but there remains a considerable amount of material that cannot be identified. Two pieces of raupo with burnt ends and a twisted circle of native passionfruit vine (*Passiflora tetrandra*) about 6 cm in diameter were found in Occupation 3. Of the leaf material, those of the kamahi (*Weinmannia racemosa*) were present in all layers except layer 11. This tree is still growing in the area today.

Most of the seeds found were rat-gnawed and, as the territorial range of the kiore cannot be great, most of the gnawed seeds including the matai seeds must have come from the cave vicinity. The five-finger seeds (*Pseudopanax arboreum*) from layer 11 also represent kiore food. Leaves from this plant were common in most of the layers.

Table 4. List of botanical specimens identified from Site N94/7.

Name	Occupation 1		Occupation 2	Occupation 3	type
	period 1	period 2			
NATIVE SPECIES					
Titoki					
<i>Alectryon excelsus</i>	—	—	—	X	seeds
Astelia					
<i>Astelia</i> sp.	—	—	—	X	leaves
Fern					
<i>Blechnum vulcanicum</i>	—	—	X	—	leaves
Monocot.					
<i>Bulbinella</i> sp.	X	X	X	X	leaves
Sedge					
<i>Carex</i> sp.	—	—	—	X	leaves
Epiphyte					
<i>Collospermum hastatum</i>	—	—	—	X	leaves
Cabbage tree					
<i>Cordyline australis</i>	—	—	—	X	leaves
Karaka					
<i>Corynocarpus laevigatus</i>	X(?)	—	—	X	seeds
Cucurbitaceae sp.	—	X	—	—	seeds
Sedge					
Cyperaceae	—	—	—	X	leaves
Hinau					
<i>Elaeocarpus dentatus</i>	—	—	—	X	seeds
Kiekie					
<i>Freycinetia banksii</i>	—	—	—	X	leaves
Gourd					
<i>Lagenaria</i> sp.	X	—	—	X	fruit
	—	—	X	—	seeds
Manuka					
<i>Leptospermum scoparium</i>	—	—	X	—	seeds
	—	—	X	—	branches
	—	—	X	—	leaves
King fern					
<i>Marattia salicina</i>	—	—	—	X	leaves
Mahoe					
<i>Melicytus ramiflorus</i>	—	—	X	—	leaves
Beech					
<i>Nothofagus truncata</i>	X	—	—	—	leaves
N.Z. passion flower					
<i>Passiflora tetrandra</i>	—	—	—	X	vine
Flax					
<i>Phormium tenax</i>	X	—	X	X	leaves
Fern					
<i>Phymatodes diversifolium</i>	—	—	—	X	leaves
Five-finger					
<i>Pseudopanax arboreum</i>	—	X	—	X	leaves
	X	—	—	—	seeds
Bracken					
<i>Pteridium esculentum</i>	X	X	X	X	leaves
	X	X	X	X	stalks
Matai					
<i>Podocarpus spicatus</i>	X	X	X	X	seeds
Raupo					
<i>Typha orientalis</i>	—	—	—	X	leaves
Kamaha					
<i>Weinmannia racemosa</i>	—	X	X	X	leaves
EUROPEAN INTRODUCTIONS					
Dock					
<i>Rumex</i> sp.	—	—	—	X	leaves
Sisal					
<i>Agave sisalana</i>	—	—	—	X	fibre
Cotton	—	—	—	X	woven
Wool	—	—	—	X	woven

The possibility that Cucurbitaceae seeds from Occupation 1, period 2, (layers 7 and 9, square 67) were deposited there by a burrowing rat has been mentioned above (p. 56). If this is not the explanation, then one would have to postulate that the seeds represent the presence of a botanical species not previously known to have been present in pre-European times. There is some possible comment on this argument. Banks (Beaglehole 1962, 1 p. 417) when talking of gardens seen at Anaura Bay comments:

In them were planted sweet potatoes, cocos and some one of the cucumber kind, as we judgd from the seed leaves which just appeard above ground; the first of these were planted in small hills, some rangd in rows other in quincunx all laid by a line most regularly, the Cocos were planted on flat land and not yet appeard above ground, the Cucumbers were set in small hollows or dishes much as we do in England.

Banks later was able to state clearly that gourds were grown in New Zealand (Beaglehole 1962, 2 p.9) so that the cucumber plants he saw at Anaura Bay may have been young gourd plants or they may have been something different.

What part the podocarp and dense hardwood forests really played in the economy of the early inhabitants of the Taupo area is hard to ascertain. There probably was extended foraging with the people working the open areas between the forest stands and making full use of the hardwood-scrub forest fringes for bird hunting and for plant foods and materials. Beveridge (1964) has some interesting comments on podocarp fruiting and the associated bird life. However, only a few seeds from podocarps or any forest plants were found in the cave. This may be the result of not using flotation methods, although sieving was carried out.

Although in Occupation 1 the majority of bird bones found represented forest dwelling species, probably many could be caught on the forest fringes as well. The evidence seems to suggest, especially for such birds as the tui and red-crowned parakeet, that it was these fringes that were exploited economically. Once the forest and scrub were destroyed, later peoples had to adapt to an altered environment and evolve new economic approaches in order to survive in the area.

ARTIFACTUAL MATERIAL

Although a considerable amount of artifactual material was found, practically all was incomplete or fragmentary. There were marine shells, woven material, gourds and some bone artifacts. Most of these have been discussed. Other material such as pieces of worked wood, stone and pumice are not included in this paper except in the following short description of a few of the more important items.

Two bone needles were present. A.R. 5739 came from Occupation 2 (square 34, layer 5). It measured 11 cm. The other, A.R. 5936, from Occupation 1, period 1, was about half the size and had the eyelet broken. An attempt had been made to redrill the hole on one side but it was not completed.

A broken bird spear (Fig.15) was also found in Occupation 1, period 1, in a fissure between the rocks in square 46. This indicated at least one of the methods used for catching birds at that time.



Fig. 15. Broken bird spear, Occupation 1, period 1, square 46, layer 11.

A small bird-bone toggle, broken in half, came from Occupation 3 and the handle of a stone flax-pounder from the same occupation can be associated with the increased flax-working.

Three very small chips from one or more polished adzes in Occupation 1, period 1, indicated that adzes were used during that occupation.

A considerable amount of worked and carved pumice occurred throughout the deposits. A small pumice adze "model", square in cross-section and measuring about 8.5 cm long was found in Occupation 1, period 1. It may have been a child's toy. Other pumice pieces, varying from round to oval, were hollowed out to form "bowl-like" containers. These were in all stages of manufacture and may have been prepared for removal elsewhere. Their purpose or use is not clear. Other pumice pieces were formed in oval or round shapes in outline but flattened top and bottom. None showed signs of use and, once again, they may have been "blanks" for export. Other pieces had the appearance of having been used as net floats as they had holes drilled through them. One small flattened piece with a central hole came from Occupation 1, period 1.

Two broken pumice patu were found in the later periods. A.R. 5738 came from Occupation 2 (Fig. 16) and A.R. 5787 from Occupation 3 (Fig.17). This patu had been broken in half and later joined together by drilling holes above and below the break and tying the two pieces together with flax. Later the handle broke and it was discarded. These may have been design models, practising weapons or children's toys but they reflect the later proto-historic disturbances in the area.

Obsidian

Approximately 981 pieces of obsidian were present in the site. Occupation 1, period 1, contained 244 pieces, 24.9% of the site total; Occupation 1, period 2, 67 pieces, 6.8%; Occupation 2, 433 pieces, 44.1%; Occupation 3, 237 pieces, 24.2%.

Of the 981 pieces, 179 showed some weathered cortex surface. Of these 179 pieces (over 18% of the cave total), 36 came from Occupation 1, period 1, representing 14.75% of the layer total; Occupation 1, period 2, 6 pieces, 9%; Occupation 2, 78 pieces, 18% and Occupation 3, 59 pieces, 24.9%.

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Figs. 16, 17. Pumice artifacts. 16. Broken pumice patu, Occupation 2. 17. Broken and repaired pumice patu from Occupation 3.

The source of the water-rolled, boulder-type obsidian is at Whangamata Bay in the Western Bay of Lake Taupo. Pebbles and small boulders can still be picked up on the beach there. It has already been suggested that a canoe would be necessary to collect any amount more than a few small lumps.

Taupo obsidian has been discussed by Green (1962, 1964); Green *et al.* (1967); and Ward (1973).

Obsidian quarries were worked at some stage, further inland along the Whangamata fault (Ward 1973, pp. 93, 100). It is not known whether the cave inhabitants knew of these quarry areas or had access to them, but the amount of cortex pieces suggests Whangamata Bay as the most likely source of the cave obsidian, although other sources may have been worked. Evidence suggests that pebble material was brought to the cave to be worked at leisure rather than being prepared at the collection point.

Both used and unused flakes, including a number of small chips, were present and a few pieces showed secondary flaking. It seems likely that one of the activities of the people in the cave was the preparation of obsidian "cores" to take away. Transport problems would make it necessary to remove any excess weight or bulk first as a considerable amount of walking was required before water transport could

aid travellers (unless only small quantities were being removed at a time). One of the advantages of Mayor Island obsidian must have been the ability to carry large amounts by sea to almost any coastal part of New Zealand. Even if Taupo obsidian had been discovered at a fairly early period, its distribution in bulk, except to selected areas locally, would present logistic problems.

In spite of this, Taupo obsidian had reached Palliser Bay in small amounts by the fourteenth century (Leach 1976, Appendix 17). Evidence from the cave indicated that during the fourteenth and fifteenth centuries, materials, especially obsidian, were being prepared for removal elsewhere. Leach (1976, pp. 174-5) suggests that:

There was a significant communications link with the resources of the central North Island in the middle of the prehistoric sequence. However this channel apparently dried up some time before the 16th century. Because the contact with the Coromandel-Bay of Plenty continued with only minor reductions at this time, it would appear that material from this area was not coming down through the centre of the North Island on an overland route. A seaward or coastal passage seems more likely.

Occupation 2 at Whakamoenga suggests that trade was still continuing but the outlets are unknown at present. It is possible that it also continued during the early part of Occupation 3 while the first and gradual increase of European influence occurred.

The lack of Mayor Island obsidian in the cave indicates that the earliest sites in the Taupo area have not yet been discovered as it would be expected that early sites would show at least some Mayor Island obsidian, if not the amount shown at Tokoroa (Law 1973).

Preliminary results of hydration rim measurements on obsidian from the cave are discussed in Appendix 3.

SUMMARY AND CONCLUSIONS

Excavations at Whakamoenga Cave show that the site has been used for habitation discontinuously for 500-600 years or possibly longer.

A cavity in the cliff face was formed at a time when the lake was higher than its present level and, when the water retreated, a shingle and pumice rubble beach remained on the floor of the cave. The cave floor was scattered about with water-worn boulders and later more rocks fell on to the shingle. It was on this shingle and pumice that the first occupation occurred.

The nature of this "beach" shore was such that the earliest deposits were mixed into it. Some haangi were dug, especially in the areas of squares 57, 66, 67, where talus deposits formed a softish layer over the beach layer beneath the entrance. Large ignimbrite stones were gathered either from the shingle floor or, more likely, from beaches nearby to use in the haangi.

There was no evidence for structures during the first occupation and the nature of the shingle base would not have been stable enough to support posts or stakes, although there were a few shallow irregular "stake" holes in the shingle. Some of the rock heaps lying on the floor might have been used as stake

supports for wind-breaks or similar structures but no evidence was found for this. It is not known whether the south-west entrance was open or blocked at this time.

The first main occupation, from its distribution, composition and Carbon 14 dates, seems to have consisted of two periods but with little differentiation between them.

Occupation 1, period 1, has a Carbon 14 date of 605 ± 56 B.P. and lasted long enough for a black charcoal and humus layer to build up on the pumice rubble over the front half of the cave floor. Hosking's layer 11, the first layer in period 1, was rather unevenly distributed owing to the nature of the substrate but this became more consolidated as living debris built up.

This occupation appeared to have a definite distribution of activities, partly imposed on it by the nature of the cave floor and partly from choice within those areas. Certain places took on specific functions, suggested by the presence and nature of the cultural material. These areas may be described as a vestibule at the entrance, a cooking area on one side and a working area amongst rocks 27, 26 and 14. No sleeping area could be recognized but there were sheltered and rock-free, though rather darker, portions further back in the cave that could have been utilized for this purpose.

During Occupation 1, period 1, a large variety of bush birds were caught. No immature birds were present, possibly indicating that birding was not being carried on in the spring and early summer because the group had moved on by then. Some immature moa bones, as well as adult bone, were found in Occupation 1 but little is known of moa breeding patterns and young moa might still be "immature" for a period of up to a year. Water birds were also important. Evidence was found for *Galaxias* sp. and *Hyridella*. *Rattus exulans* bones were present but it is not known whether these animals were eaten or present as breeding populations, or both.

Flax and other fibrous materials were utilized for plaiting and binding, gourds were used for containers and bracken fronds were present. Byrne's (1973) analysis of human coprolites has produced evidence for fern root consumption in Occupations 2 and 3 but indications for this food are lacking in Occupation 1, although it was probably an item in the diet.

Of the materials foreign to the area, sea shells, especially *Amphidesma* species, were used at this period. These shells all showed signs of heavy wear-flaking around their edges, suggesting their use as scrapers of some sort. Practically all were broken. There is no direct evidence to suggest what was being scraped, although fern root is a possibility. No flax fibre was found although flax leaf was being used.

Some, at least, of the obsidian was collected from Whangamata Bay and processed in the cave. The amount of cortex waste suggested that the shaping of obsidian cores and the elimination of unnecessary bulk and weight for carrying elsewhere may have been one of the reasons for the early cave occupation and possibly for the later occupations as well.

Law (1973, p.162) speculates that the Tokoroa site, N75/1, could represent an extended family on a protracted halt in the area. This speculation could well be applied to Whakamoenga Cave, during Occupation 1, when it appears to have acted as a suitable base from which to operate for a period, either for exploration or exploitation of certain resources such as collecting obsidian, or preserving food to take away. The presence of a broken bird spear, a small broken needle, a miniature pumice adze taken together with the estimated floor space available could well fit the idea of a small extended family group utilizing the cave for a period.

Given the Taupo climate, one would expect that groups would be likely to visit the site during the summer. However, the natural food resources and their availability equally suggest that the late winter and early spring were more suitable, especially since crop growth, such as of kumara, would be very marginal. The cave would afford much more warmth and shelter and more protection from the elements than an open air site. There were ample supplies of timber nearby and the cave was in a central position from which to operate, provided a canoe could be used. It seems that the size of the cave, its protection and geographic and strategic position rather than its immediate economic resources were what made it important. Using it as a base, with a canoe, the whole lake environment could be exploited with the minimum of energy expended and this was so from the earliest occupation.

Occupation 1, period 2, with a Carbon 14 date of 479 ± 55 B.P. appeared to be similar to period 1 except that there was a redistribution of some activities in the cave either due to a small rockfall, a rearrangement of rocks or a break in the continuity of the occupation. The midden and cultural material were similar but on a smaller scale. Several Cucurbitaceae seeds from a plant not previously known to have been grown by the Maoris were found but it is possible that these may have been introduced from the higher "European" levels by rats.

During, or more probably after, Occupation 1, the cliff overhang collapsed and a rockfall covered the early occupation. The fall was prevented from rolling further into the cave by the upstanding rocks in squares 45 and 46. These dammed the rockfall, leaving the back of the cave very much as it had been originally. This portion of the cave had not been used during Occupation 1 but loss of the front overhang let more light into this area though the front portion remained piled up with rocks.

By this time most, if not all, of the bush around the lake had been destroyed and replaced by fern and scrub. Sometime later, renewed activities (Occupation 2) occurred behind the rockfall. Evidence included floor material brought in from outside or from around the rockfall, forming a series of lenses and layers over the back of the cave, covering the small Occupation 1, period 1, deposits that extended into squares 35 and 36 and also covering the remaining beach deposits.

A number of haangi and fire-pits were dug into these deposits and samples from two haangi gave similar dates of 279 ± 55 B.P. and 249 ± 59 B.P.

Occupation 2 contained no evidence for moa hunting. About the same number of water birds were present as in Occupation 1 but the number of forest birds decreased considerably. Tui and kaka, however, were still being caught. *Hyridella*

numbers increased, suggesting that they were being used to replace birds as a source of protein. Marine shells, especially *Amphidesma* species, showed a marked increase. These were heavily wear-flaked and most were broken. More *Perna* shells were present, with the dominance of the left valve over the right becoming apparent, suggesting more flax working, and worked flax was found. Gourds were also in use.

Bracken rhizome fibres found in human coprolites from Occupation 2 provide evidence for fern root consumption and this, together with the decrease in forest birds, shows that a different economic pattern had developed due, in some part, to the loss of forest in the area.

Obsidian flakes were the most numerous in this occupation, possibly reflecting exploitation of the inland quarries as well as the Whangamata sources. Increased demand, population pressure or improved communications which allowed a more efficient trading system to develop are possible reasons for this increase.

Broken pieces of a pumice patu from this occupation suggested that power struggles and warfare were affecting people in, or coming to, the area. Pumice bowls and other pumice objects continued to be manufactured and several pieces of a consolidated rhyolitic pumice stone showing "adze sharpening" grooving were found, suggesting that adzes, although not present as artifacts in the cave, were in use.

Although there is no definite break in layers, by Hosking's layer 4 European material began to appear. These uppermost layers have been grouped as Occupation 3.

The number of *Hyridella* shells more than doubled and fern root consumption, which appeared to become important in Occupation 2, continued but with less trouble being taken in its preparation. All bird and fish remains decreased and very few *Amphidesma* shells occurred. There was an increase in the number of *Perna* shells, especially the left valve, which appeared to be the preferred one for flax and fibre scraping, at least in more recent times. The presence of large numbers of these shells is paralleled by the increased amount of prepared fibre and woven material. Obsidian still continued to be important in the early part of Occupation 3, suggesting a continued demand for this material either for use locally or for export.

In the upper layers of Occupation 3, muskets are represented and another broken pumice patu was found. There is historical evidence for increased warfare, pa building, political manipulations and the establishment of several permanent tribes such as the Tuwharetoa in the area. These tribes were able to remain in the area and maintain political influence because of the increasing availability of European economic items such as muskets, potatoes, pigs and trade goods.

Whakamoenga Cave excavations are important to New Zealand prehistory because the occupations cover a considerable time and have produced a large amount of material not normally found in open sites. It is also one of the few

inland sites to be excavated scientifically. This report only studies certain aspects of the material found but nevertheless establishes the foundation on which later work may be based.

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APPENDIX I

Analysis of human coprolites from N94/7 (after Byrne 1973, Table 15).

1 g samples		General description	Plant identification	Proportions
Square 24 or 33 21WAK (Layer 1) Sample I	Occupation 3	Very coarse Large no. of components	Bracken rhizome	30%
Square 24 or 33 22WAK (Layer 1) Sample I	Occupation 3	Material coarse Large no. of components	Bracken rhizome	20%
Square 34 23WAK (Layer 5) Sample I	Occupation 2	Coarse to fine Large no. of components	Bracken rhizome Epidermis	10% 20%
Sample II		Fine and pulpy Medium no. of components	Bracken rhizome Epidermis	5% 40%
Square 34 27WAK (Layer 7) Sample I	Occupation 2	Very fine and pulpy Medium no. of components	Bracken leaf frag.	1 only
Square 43 25WAK (Layer 10) Sample I	Occupation 1/1	Fine and pulpy	Epidermis	5%
Square 43 26WAK (Layer 11) Sample I		Coarse to fine Medium no. of components		
Sample II	Occupation 1/1	Very fine Medium no. of components	Epidermis	10%

APPENDIX 2

Report on human bone from N94/7

P. Martin Reeve

Auckland Medical School

There are twelve bones and bone fragments of which ten are definitely human and two probably human. All except the two latter fragments are from the skull. There could be the remains of up to eight individuals or as few as two, with the most likely number being three. Few conclusions can be drawn about the individuals, except that one was probably a female of about 30-40 years, another was of about the same age and a third was somewhat older and suffered an osteolytic lesion of the skull, the latter two of indeterminate sex and race.

AR 5760.

This is a frontal bone, complete except for the right orbital roof and right temporal region. It is rather thick, but of moderate dimensions, and the markings are not pronounced. The lacrimal bones and the frontal processes of the maxillae are attached but not fused, while the horizontal plate of the ethmoid with a prominent crista galli is attached and fused. There appears to be a small area of charring on the right exterior surface of the bone.

AR 5749

This specimen is a portion of the temporal and sphenoid bones which are joined but not fused. The temporal portion is the anterior part of the squamous temporal bone including the root of the zygomatic arch and the mandibular fossa, the sphenoidal part is most of the greater wing including part of the orbital wall and the foramen ovale.

AR 5749C

This is a portion of the right parietal bone, being its antero-inferior angle, and there is present the margin that forms part of the pterion, the margin that forms the inferior end of the coronal suture and the margin that forms the anterior part of the parieto-temporal suture, none of which show evidence of fusion. There is a well marked groove for the anterior branch of the middle meningeal artery on its interior surface.

AR 5749D

This is a portion of the right temporal area of the frontal bone, with prominent vascular markings on its interior surface.

The above four bones can be positively fitted and interlocked together, and there is no doubt that they all come from the same individual.

AR 5726

This is a portion of the right side of the squamous part of the occipital bone, on its external surface is a slightly marked superior nuchal line, and on its interior surface is the groove for the right transverse sinus, but the internal occipital protuberance is eroded away.

AR 5799

This is a portion of the left side of the squamous part of the occipital bone, larger in extent than the previous fragment. The external and internal surfaces are similar to the above bone, but there is in addition part of the occipital contribution of the lambdoid suture which shows no sign of fusion.

The two bones cannot be positively fitted together, but there is no overlap and it is likely that they are from the same occipital bone.

AR 5726

This is the right maxilla which has lost most of its superior part. There is a well developed maxillary antrum, but because of the lost bone its roof is missing. The alveolar arch is well developed but no teeth are present. However all the tooth sockets are well developed and there is no evidence of dental disease. The dentition is a fully erupted complete adult set with the presence of an unusual fourth molar. The dental arch is short and the bone is moderate in size.

The above three bones cannot be positively articulated with the first four described, but it is likely from their size, markings and weathering that they are all from the same skull. This is likely to have been female because of its small size, and from an individual aged about 30-40 years because of the development of the maxillary sinus and the state of the sutures.

AR 5641

This is a right temporal bone with an attached part of the greater wing of the sphenoid. The temporal bone is practically complete, except for the tegmen tympani, the zygomatic process and the lateral wall of the mastoid air cells. The sphenoidal part is nearly fused to the temporal bone and may represent an anomalous ossification of the sphenoid. It is difficult to age the bone since the absence of the lateral wall of the mastoid air cells indicates a young individual, say adolescent, but the fusion of the sphenoidal part indicates a rather older individual. Race and sex cannot be reliably determined.

AR 5749A

This is a left temporal bone complete except for the zygomatic process and the lateral wall of the air cells of the mastoid. This bone is better preserved than the one described above, is smaller and of slightly different shape. It could possibly come from the same skull, but there can be no certainty about this. Because of the poor development of the mastoid, it is likely to come from a young individual, say adolescent but again race and sex cannot be reliably determined.

AR 5645

This fragment represents a portion from the left parietal and left part of the squamous portion of the occipital bone, the lambdoid suture between them being nearly obliterated. There is a hole in the parietal portion which appears to be a healing infected lesion of the skull bone. The internal surface presents a faint groove for a branch of the middle meningeal artery and a faint groove for the left transverse sinus. Because of the state of the suture, the state of preservation of the bone and its configuration it cannot belong to the skull of the first described individual and it is most unlikely that it comes from the skull of the two temporal bones described above. It is probably from another individual aged about 50, of indeterminate race and sex.

AR 5520

This appears to be a portion of the extremity of a long bone. It is probably the anterio-lateral portion of the distal end of the left radius, but it could possibly be the popliteal surface of the right femur of a child. It is unlikely to be from the tibia, but its definite origin cannot be stated with complete certainty. Its proximal end is charred.
Uncatalogued

This is consistent with being human but cannot be positively identified as such. It is probably the lower end of an adult femur, because of the curvature of the bone, the thickness of the cortex, the absence of markings and the presence of trabeculae, which are not as well formed in mid shaft. The trabeculae are still intact, not compressed as they might be if the bone had been gripped firmly between thumb and fingers.

APPENDIX 3

Notes on obsidian dating, N94/7

Obsidian hydration rims were measured at the Anthropology Department, University of Auckland in 1962 (Green 1964). Although the results may be obsolete according to today's methods, I feel they are worth quoting (W. Ambrose, pers. comm. to T. Hosking).

Your earliest levels are possibly between 500 and 800 years old according to the hydration thickness with between 2 and 1.25 microns thick at an estimated rate of about one micron in 400 years. More accurately we could say the age of your earliest specimens is as old as the bottom levels of the Opito Beach midden site. The hydration thickness changes on samples is in conformity with your stratigraphic description which is probably more a check on our readings than on your digging.

Ambrose adds a postscript "your layer 5 material is possibly less than 200 years old."

This is a very interesting comment when one considers the Carbon 14 results.

The obsidian results from Whakamoenga may be compared with those on Mayor Island obsidian from another inland site at Tokoroa (Law 1973, p. 159). Altogether 26 readings on five surfaces of one flake were done but Law rejects some and states:

. . . the remaining 19 readings average 1.220 ± 0.021 microns. These are on average thinner, suggesting a more recent age than those from Opito (N40/3), Tairua (N44/2), Sunde Site (N38/24) and the western midden at Harataonga Bay (N30/5) which are all Archaic midden sites. The growth rate of the rim is dependent on temperature, and as all these sites are at sea level and in sand, and as soil temperatures at Tokoroa may be lower, this site may be nearer to equivalent in age to those above.

Ambrose suggests a hydration thickness range between 2 and 1.25 microns for the early levels at Whakamoenga. This appears older than the material from Tokoroa, although details of the number of flakes and readings at Whakamoenga are not available. However, the temperature in the cave must have been constantly higher than the ground temperature at Tokoroa in the winter and therefore hydration rates may have been faster than at Tokoroa. It is possible that Occupation 1 at the cave was closely associated in time with the Tokoroa site.

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